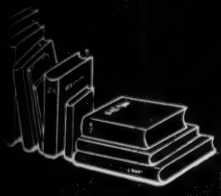
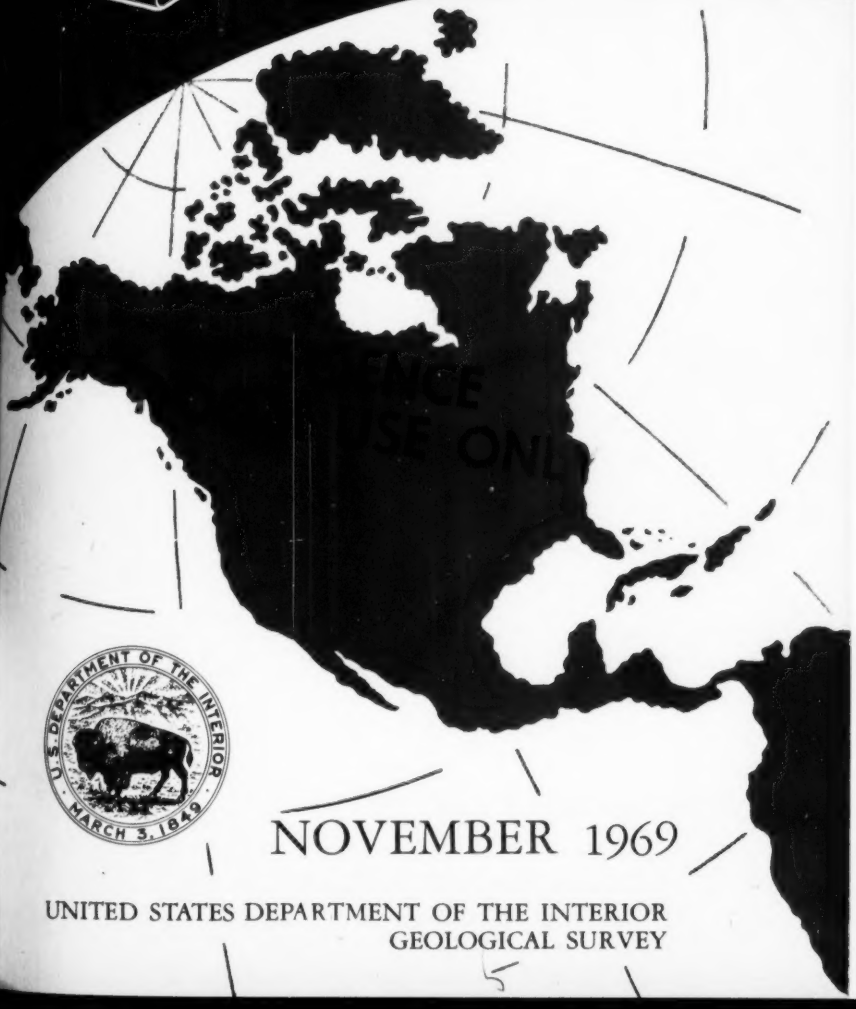
ABSTRACTS OF NORTH AMERICAN GEOLOGY





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ABSTRACTS OF NORTH AMERICAN GEOLOGY

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ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports of memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

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A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey, Washington, D. C. 20242. Serial publications cited for the first time are as follows:

Missouri Geol. Survey and Water Resources, Water Resources Rept.—Missouri Geological Survey and Water Resources, Water Resources Report. Rolla, Mo.

Nevada Div. Water Resources, Water Resources-Inf. Ser. Rept.—State of Nevada, Department of Conservation and Natural Resources, Division of Water Resources, Water Resources-Information Series Report. Carson City, Nev.

Nevada Div. Water Resources, Water Resources-Reconn. Ser. Rept.—State of Nevada, Department of Conservation and Natural Resources, Division of Water Resources, Water Resources-Reconnaissance Series Report. Carson City, Nev.

New York Water Resources Comm. Rept. Inv.—State of New York, Conservation Department, Water Resources Commission Report of Investigation. Albany, N. Y.

Oceans—Oceans. Oceans Publishers, Inc. San Diego, Calif.

Ontario Dept. Mines Prelim. Geochem. Map—Ontario Department of Mines Preliminary Geochemical Map. Toronto, Ontario, Canada.

Remote Sensing Environment—Remote Sensing of Environment. An interdisciplinary journal. American Elsevier Publishing Co. New York, N. Y.

The abstracts in this issue were prepared by Harold H. Arndt, Helen M. Beikman, F. C. Canney, Maurice A. Chaffee, George V. Cohee, Georgianna D. Conant, John R. Donnell, S. E. Frezon, Katherine A. Friberg, Andrew Griscom, Bettie S. Hackman, John L. Hass, Anna Hietanen-Makelə, John W. Hosterman, J. Steve Huebner, Charles B. Hunt, Virginia M. Jussen, B. H. Kent, Philip B. King, R. A. Loney, Elisabeth S. Loud, Mildred C. Mead, Benjamin A. Morgan, 3d, Mary E. Mrose, Willis H. Nelson, Virginia S. Neuschel, Steven S. Oriel, D. W. Rankin, Mac Ross, James D. Vine, Dorothy B. Vitaliano, Holly C. Wagner, Walter S. White, and R. G. Yates.

ABSTRACTS

Aaron, John M. *See* Drake, Avery Ala, Jr. 02457

02491 **Abaza, Mohamed M. I.; Clyde, Calvin G.** Evaluation of the rate of flow through porous media using electrokinetic phenomena: Water Resources Research, v. 5, no. 2, p. 470-483, illus., 1969.

An analytical relationship is developed that relates the rate of flow through porous media to the streaming current I and streaming potential E induced by the flow. Thus, a measurement of either E or I would give a value related to the rate of flow. Laboratory experiments were conducted to test the analytical relationship. The effects of the concentration of dissolved salt in the percolating solutions, the size of the particles forming the beds, and the temperature of the solution on the streaming current and the streaming potential are determined. The analytical relationships, together with the experimental work, form the basis of a method of measuring the rate of flow through porous media.—*from* Authors' abstract

Aboudi, J. *See* Alterman, Z. S. 02509

07566 **Abrol, I. P.; Palta, J. P.** Bulk density determinations of soil clods using rubber solution as a coating material: Soil Sci., v. 106, no. 6, p. 465-468, 1968.

From amongst the materials (paraffin wax, collodion, and rubber solution) used for coating soil clods, the rubber solution gave the least average increase in weight and volume on coating, and the minimum standard deviation in bulk density.—JWH

Ackermann, H. D. *See* Sutton, R. L. 02145

07561 **Adams, John B.** Differential solution of plagioclase in supercritical water: Am. Mineralogist, v. 53, nos. 9-10, p. 1603-1613, illus., tables, 1968.

When plagioclase feldspar is held in H_2O at 500°C to 800°C at 2 kbar the albite components are removed in solution whereas the anorthite components remain as a relatively insoluble residue. Solution is so selective that the anorthite residuum typically forms a pseudomorph after the original plagioclase, preserving details of grain outline, cleavage and twinning. The volume deficiency of a pseudomorph is manifested by an intricate network of interconnecting channelways. Although albite is removed without apparent disruption of its parent plagioclase crystal, several lines of evidence indicate that the anorthite component also enters into solution but is immediately reprecipitated.—Author's abstract

Adamski, Joseph A. *See* Lipson, Herbert G. 07580

07546 **Adler, Hans H.** Infrared spectra of phosphate minerals—Splitting and frequency shifts associated with substitution of PO_4^{3-} for AsO_4^{3-} in mimetite ($Pb_5(AsO_4)_3Cl$): Am. Mineralogist, v. 53, nos. 9-10, p. 1740-1744, illus., table, 1968.

Spectral data for the substitution of the phosphate group for arsenate in the mimetite lattice are presented, and the symmetry of the phosphate group is discussed. The splitting of the ν_4 frequency permits recognition of phosphate substitution in mimetite.—JSH

Adolphson, Donald G. *See* Ellis, Michael J. 02565

02375 **Aguirre, Emiliano.** Evolutionary history of the elephant: Science, v. 164, no. 3886, p. 1366-1376, illus., 1969.

A tentative phylogeny of Elephantidae based on morphological and quantitative analyses is given. It is uncertain to what extent many of the quantitative differences can be explained as simple variations resulting from local conditions of climate and food supply. Morphological variations are large; thus the affinities and trends in form have to be established carefully. It is probable that the diversification of elephants summarized in this paper relies on a genetic basis, and it is very difficult to decide at what moment the interbreeding of different forms has terminated.—KAF

02171 **Ahmad, N.; Jones, Robert L.** Genesis, chemical properties and mineralogy of Caribbean grumusols: Soil Sci., v. 107, no. 3, p. 166-174, tables, 1969.

Caribbean grumusols (dark clay soils) are formed on calcareous material over a wide range of rainfall (100-190 cm/year) in Trinidad, Jamaica, Barbados, and Antigua, and on fine-grained compacted volcanic ash in Dominica. The soils are clay in texture and have a composition similar to the insoluble residues. Calcium is the dominant exchangeable cation in the calcareous soils and magnesium in the volcanic ash soil. The clay fraction in both soils is highly montmorillonitic.—JWH

02561 **Ahrens, Thomas J.; Petersen, C. F.; Rosenberg, J. T.** Shock compression of feldspars: Jour. Geophys. Research, v. 74, no. 10, p. 2727-2746, illus., tables, 1969.

Oligoclase and microcline are found to have Hugoniot elastic limits of 40-55 and 80--85 kb, respectively; these increase slightly with increasing driving shock pressure. Above the plastic limit, transition regions of anomalously high compression are observed for microcline and oligoclase. These and earlier data indicate that at successively higher shock pressures within this region feldspars gradually transform to a high-pressure, high-density polymorph, probably hollandite. The zero-pressure density and Birch-Murnaghan equation of state parameters for the adiabat and isotherm are calculated for the high-pressure polymorph of oligoclase, microcline, anorthosite, and albitite. At 180 kb about 15 percent of the hollandite phase forms, but reverts to a lower-density phase on pressure release. Feldspathic material from meteorite and laboratory impacts converts to hollandite upon shock compression, and upon release probably reverts to maskelynite.—DBV

Akers, J. P. *See* Repenning, C. A. 02251

02523 **Akright, Robert L.** Exploration geochemistry: Mining Eng., v. 21, no. 2, p. 75-76, illus., 1969.

Papers given at the second International Geochemical Exploration Symposium held in Golden, Colorado in 1968 are reviewed. Some of the topics included are as follows: use of surface waters as a prospecting tool, atomic absorption analysis, use of mercury as a pathfinder element, solubility of gold, sample processing, biogeochemical prospecting, and geochemical prospecting case histories.—MAC

02166 **Al-Dhahir, Z. A.; Morgenstern, N. R.** Intake factors for cylindrical piezometer tips: Soil Sci., v. 107, no. 1, p. 17-21, illus., 1969.

Flow through a piezometer installed in the soil constitutes one of the best methods for in-situ determination of permeability. The presence of a borehole is insignificant and the influence of sealing both ends of the tip is small. Where comparable, the results agree with the electric analog studies.—JWH

Alexander, Shelton S. *See* Merkel, Richard H. 02502

07663 **Allen, Eldon P.; Wilson, William F.** Geology and mineral resources of Orange County, North Carolina: North Carolina Div. Mineral Resources Bull. 81, 58 p., illus., tables, geol. map, 1968.

The county is located in the Piedmont and contains three types of rocks. Ordovician(?) metavolcanic-metasedimentary rocks are divisible into four units and have been tightly folded. Igneous intrusive rocks of Devonian(?) or later Paleozoic age range from granites to ultramafic rocks and have been intruded along shear fault and fracture zones. Triassic sedimentary rocks occur in the southeastern corner of the county, in the Durham basin. Intrusive into the sedimentary and pre-Triassic rocks are discordant diabase dikes of Late Triassic or early Jurassic age. Numerous abandoned mines and prospect sites exist in the county that have been worked in the past for gold, copper, and iron. At present, pyrophyllite, crushed aggregate, building stone, and gravel are being commercially mined.—*from* Authors' abstract

02118 **Allen, Jack C., Jr.** Petrology of an orbicular granite from the Flint Creek Range, central-western Montana [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 1, 1969.

02196 **Allen, Victor T.; Fahey, Joseph J.; Ross, Malcolm.** Kaolinite and anauxite in the Ione Formation, California: Am. Mineralogist, v. 54, nos. 1-2, p. 206-211, tables, 1969.

Five new chemical analyses and X-ray studies of the kaolinite-like clays of the Ione Formation, near Ione, Calif., give the correct kaolinite chemical formula with Si:(Al + Fe + Ti) ratios of 0.985, 1.012, and 0.995. X-ray powder patterns indicate partially disordered kaolinites. A new chemical analysis of a sample from the sandstone of the Ione Formation of the Mokelumne River, Calif., confirms older analyses with high Si:(Al + Fe +Ti) ratios not compatible with the theoretical kaolinite formula. Treatment of this material with sodium hydroxide reduced the Si:(Al + Fe +Ti) ratio to 1.000. X-ray powder photographs before and after leaching with NaOH are identical and typical of disordered or partially disordered kaolinites. The excess silica is probably in the form of amorphous colloidal silica and may have been deposited within the kaolinite platelets after their deposition.—Authors' abstract

07574 **Allen, William H., Jr.** Pedo-geomorphic elements of the channel and floodplain of a small Nebraska watershed: Iowa Acad. Sci. Proc. 1968, v. 75, p. 243-252, illus., tables, 1968.

Pedologic and geomorphic data are combined in this study in an effort to delineate the areal extent of floodplains and possible extent of overbank flooding. Hydraulically, this procedure may prove most useful in studying flood routing problems on ungaged watersheds; however, it may be applied to previously studied catchments in an effort to define more accurately the areas of localized inflow and (or) major hydrologic changes which may be expected to occur in a down-valley direction.—Author's abstract

02178 **Allmann, R.; Donnay, J. D. H.** About the structure of iowaite: Am. Mineralogist, v. 54, nos. 1-2, p. 296-299, tables, 1969.

Iowaite, which weathers to pyroaurite and is similar to it in crystal data and powder-line intensities, should be isostructural with it and be reformulated as $[Mg_4Fe(OH)_{10}]^+ \times [Cl(HO)_{x-1}]^-$, $x=4$, $Z=3/5$.—Author's abstract

02509 **Alterman, Z. S.; Aboudi, J.** Seismic pulse in a layered sphere—Normal modes and surface waves: Jour. Geophys. Research, v. 74, no. 10, p. 2618-2636, illus., tables, 1969.

An exact solution is obtained for displacement of the surface of a layered sphere caused by an explosive point source within the sphere. The solid elastic mantle and fluid core have densities and elastic constants taken as averages for Bullen's model B. For modes of periods 4 sec and longer seismograms, computed at several distances from deep and shallow sources, show Rayleigh waves, higher-mode surface waves, and reflected and diffracted waves. Stonely waves are found to be due to a source located on the interface. Rayleigh waves are more highly dispersed in the layered than in the homogeneous sphere. Second-mode surface waves have a larger angularthan radial component, and in most cases a larger angular component than any

other arrival. The third higher-mode surface waves have a larger radial component. The correspondence between reflected pulses and several modes of surface waves is discussed.—*from* Authors' abstract

02449 **Anderson, A. T.; Greenland, L. P.** Phosphorus fractionation diagram as a quantitative indicator of crystallization differentiation of basaltic liquids: Geochim. et Cosmochim. Acta, v. 33, no. 4, p. 493-505, illus., tables, 1969.

Distribution factors of phosphorus (P in mineral/P in liquid) between phenocryst minerals and coexisting basaltic groundmass are given. The P ratio facilitates quantitative comparison of the variation of major and minor elements with crystallization of basaltic liquids. Knowledge of the individual mineral/liquid distribution factors makes it possible to estimate the relative proportions of crystallizing minerals from the slopes of curves of a P fractionation diagram prior to the crystallization of apatite or other P-rich minerals. This was done fairly successfully for the Alae Lava Lake, Hawaii.—*from* Authors' abstract

07649 **Anderson, Franz E.** Seaward terminus of the Vashon continental glacier in the Strait of Juan de Fuca: Marine Geology, v. 6, no. 6, p. 419-438, illus., table, 1968.

The oldest sediments collected from the Strait of Juan de Fuca, connecting the Pacific Ocean with Puget Sound, range from 21,000 to more than 30,000 yr B.P.; texture and forams indicate deposition in a quiet-water, shallow estuarine environment during Olympia Interglaciation. Overlying these are glaciomarine-like sediments of ice-rafted pebbles in a fine-grained matrix in the age range 17,000 to more than 21,500 yr B.P., corresponding to the advance of Vashon ice into Puget Sound. Vashon ice halted in the easternmost strait and formed a series of terminal and recessional moraines; later it retreated from Puget Sound region and isostatically depressed basins filled with marine waters. Only the coarsest fraction of sediments deposited during ice retreat remains in the strait.—*from* Author's abstract

02255 **Anderson, L. A.; Johnson, G. R.** Bedrock depth by resistivity soundings, Middle Fork of the Koyukuk River, *in* Some shorter mineral resource investigations in Alaska: U.S. Geol. Survey Circ. 615, p. 5-11, illus., 1969.

Six resistivity soundings were made near the town of Wiseman and Porcupine Creek on the Middle Fork of the Koyukuk River in Alaska. The purpose of the soundings was to evaluate this method as a means of determining bedrock depths in the vicinity of the main stream channel as the first step in appraising the potential of the Middle Fork valley for a gold-dredge operation. Considerable difficulty was met in interpreting the soundings in the absence of detailed geologic control, but a reasonable interpretation of bedrock depth at Porcupine Creek is 60 feet and at Wiseman, 13 miles north, 270 feet. The reason for the rather large difference in bedrock depths at the two locations is unknown.—Authors' abstract

02562 **Anderson, Rockne S.; Latham, Gary V.** Determination of sediment properties from first shear-mode Rayleigh waves recorded on the ocean bottom: Jour. Geophys. Research, v. 74, no. 10, p. 2747-2767, illus., tables, 1969.

First shear-mode Rayleigh waves from 5 shallow focus earthquakes with epicenters in the Mid-Atlantic Ridge have been recorded by a hydrophone on the ocean bottom (5.7 km deep) 260 km northeast of Antigua, West Indies, and by short-period seismographs at Bermuda. Comparisons of theoretical dispersion curves, computed as a function of sediment thickness and shear velocity gradient, with observed dispersion data give estimates of average sediment thicknesses between 0.5 and 0.9 km. Average sediment thicknesses derived from profiler results in the same region are consistently smaller than those from dispersion results. The required average shear velocity for a layer of sediment 150 m thick is found to be approximately 75 kmps.—*from* Authors' abstract

02119 **Antweiler, J. C.** Changes in composition and physical characteristics of gold particles in ancient conglomerates of northwest Wyoming in relation to source areas [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 1-2, table, 1969.

02549 **Armstrong, J. E.; Tipper, H. W.; Hoadley, J. W.; Muller, J. E.** Geology, McLeod Lake, British Columbia: Canada Geol. Survey Map 1204A, scale 1:253,440, text, 1969.

The western two-thirds of the McLeod Lake map-area consists of heavily drift-covered rolling country, of low hills, lakes, and swamps, forming the northeastern part of Nechako Plateau. In the southeast corner, glacial deposits are widespread, with depths up to 400 feet. Bedrock exposures are sparse and much less extensive than suggested by the map, thus impeding structural interpretation. The McLeod Lake fault, the outstanding feature, separates the rock sequence of central British Columbia on the west from the Rocky Mountain sequence on the east; to the north it continues along the western edge of the Rocky Mountain Trench. Numerous N- and NE-trending faults are thought to be normal or strike-slip faults. Small amounts of cinnabar, placer gold and platinum, galena, sphalerite, and others are present.—MCM

02120 **Armstrong, Richard Lee.** Geochronology of the eastern Basin and Range Province, eastern Nevada and western Utah and the Colorado Plateau, Utah, Colorado, Arizona and New Mexico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 2, 1969.

Atwater, Tanya. *See* Menard, H. W. 02574

02316 **Ayres, L. D.** Setting Net Lake area, District of Kenora (Patricia Portion): Ontario Dept. Mines Prelim. Geol. Map P. 538, scale 1 in. to 1/4 mi., text, 1969.

02553 **Ayres, L. D.** (compiler). Northern Patricia Portion, District of Kenora: Ontario Dept. Mines Prelim. Map P. 526, scale 1:1,584,000, 1969.

02121 **Babcock, G. B.; Picard, M. Dane.** Stratigraphy of the Spearfish Formation (Permian-Triassic), northern Black Hills region [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 2-3, 1969.

02398 **Baer, A. J.; Norris, D. K.** (editors). Research in tectonics—Workshop, Ottawa, 1968: Canada Geol. Survey Paper 68-52, 373 p., illus., tables, 1969.

This symposium on research in tectonics was held in Ottawa on March 14-15, 1968. Aside from the opening remarks, there are fourteen published papers, each including a discussion with replies by the authors. Each paper is cited individually. D. K. Norris conceived the idea of this conference with the purpose of bringing together a dozen or so specialists in the field of brittle failure and of kink bands, chosen evenly among laboratory and field men. Appendices of kink-band-angle nomenclature, symposium participants, and of a general program are included.—HRC

02515 **Bailey, R. A.; Smith, R. L.; Ross, C. S.** Stratigraphic nomenclature of volcanic rocks in the Jemez Mountains, New Mexico: U.S. Geol. Survey Bull. 1274-P, 19 p., illus., 1969.

Volcanic rocks of the Jemez Mountains are divided into the Keres, Polvadera, and Tewa Groups. The Keres Group, of early through middle Pliocene age, consists of Chamisa Mesa basalt, Canovas Canyon Rhyolite, Paliza Canyon Formation, and Bearhead Rhyolite; the Polvadera Group, of middle Pliocene to early Pleistocene age, consists of Lobato Basalt, Tschicoma Formation, and El Rechuelos Rhyolite; and the Tewa Group, of middle to late Pleistocene age, consists of Bandelier Tuff, Cerro Rubio Quartz Latite, Cerro Toledo Rhyolite, and Valles Rhyolite. Nomenclature of the Bandelier Tuff is revised. This unit consists of the Otowi Member, which includes the Guaje Pumice Bed, and the Tshirege Member, which includes the Tsankawi Pumice Bed. Potassium-argon dates range from 9.1 to 0.4 m.y.—RAB

02122 **Bailey, R. L.; Harp, E. L.; Jasmin, P. H.; Lahren, L. H.; Lavin, S. J.; Mackin, R. L.; Montagne, J. M.; Mueller, R. G.; Schneider, G. B.; Stradley, A. C.; Todd, S. G.** Pediments influenced by periglacial processes at Canyon Mountain, Livingston, Park County, Montana [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 3-4, 1969.

Baker, Bruce L. *See* Hodgson, G. W. 02447

02123 **Baker, Claud H., Jr.** Hot pots near Midway, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 4, 1969.

02124 **Baker, Richard G.** Pollen and seed diagrams from an abandoned lagoon on the southeast arm of Yellowstone Lake, Wyoming [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 4-5, 1969.

02125 **Balk, Christina Lochman.** Upper Cambrian faunal patterns on the craton [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 5, 1969.

Balkwill, H. R. *See* Yorath, C. J. 02384

Ball, John T. *See* Howe, George M. 07633

Ball, Mahlon M. *See* Lidz, Louis. 02363

02126 **Barker, Fred; Peterman, Z. E.; Hildreth, R. A.** Genesis of the Precambrian Twilight Gneiss, West Needle Mountains, Colorado—Implications of Rb and Sr [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 5-6, 1969.

02127 **Barker, Fred; Peterman, Z. E.; Marvin, R. F.** Precambrian melasyenite stock of Ute Creek, San Juan Mountains, Colorado [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 6, 1969.

02169 **Barnhisel, R. I.** Changes in specific surface areas of clays treated with hydroxy-aluminum: Soil Sci., v. 107, no. 2, p. 126-130, illus., tables, 1969.

The internal surface areas of montmorillonite and vermiculite clay were reduced by the addition of hydroxy-aluminum. A linear relationship between internal surface area and CEC was obtained. Both the total and internal surface areas decreased with increasing OH/Al for montmorillonite, and varied with increasing OH/Al for vermiculite.—JWH

02298 **Barshad, Isaac.** Preparation of Na saturated montmorillonites: Soil Sci., v. 107, no. 5, p. 337-342, tables, 1969.

Many bentonites due to their high degree of Ca^{2+} and Mg^{2+} saturation either do not disperse in water, or if they do, yield only small amounts of colloidal montmorillonite. Saturating such bentonites with Na^{+} eliminates this difficulty and enables the removal of such impurities as quartz, cristobalite, and feldspar.—JWH

07506 **Baskerville, Charles A.** Geology and foundation treatment of sensitive sediments—World's Fair highway complex, New York: Geol. Soc. America Eng. Geology Case Histories, no. 6, p. 55-63, illus., 1968.

The site is on a tidal valley in Flushing Meadows, which receives fresh water from runoff and salt water from East River. Evidence suggests that the deposits in the valley are from the breaching of a terminal moraine and subsequent rise in sea level. The valley floor deposits are composed of plastic organic silt and clay overlain by peat. Peat layers below the organic silt overlie clayey till, and are dated at 7000 to 9000 B.P. The organic sediments are very sensitive and have a low shear strength which increases slightly with depth because of compaction. Special foundation treatments included: relieving structures over drainage lines and light-weight fill embankments with counter-weight berms, and sand drains to increase consolidation rate with accompanying shear-strength increase.—*from* Author's abstract

02367 **Bateman, P. C.** Geology of the Sierra Nevada—Pts. 1-2: California Div. Mines and Geology Mineral Inf. Service, Pt. 1, v. 22, no. 3, p. 39-42, illus., reprinted 1969; Pt. 2, ibid., no. 4, p. 61-66, illus., reprinted 1969; originally published 1966.

Photographic illustrations have been added to these reprints from "Mineral resources of California," issued as U.S. Cong., 89th, 2d Sess., Comm. Interior and In-

sular Affairs, Comm. Print., and as California Div. Mines and Geology Bull. 191, p. 54-59, 1966.—GDC

Bates, R. G. *See* Cohee, G. V. 02276

02461 **Bates, Robert L.** The object of the game: Jour. Geol. Education, v. 17, no. 1, p. 3-5, 1969.

The main job of geology departments today, so far as graduate programs are concerned, is to prepare PhDs for teaching; however, students also are being trained to pursue high-level research, with no training in undergraduate teaching. The dichotomy between geology as a pure science and applied geology should be recognized. Most academic geologists are on the side of pure science, and advanced courses in applied geology are being withdrawn. Another field in which the demand for geologists is increasing is environmental or urban geology. Departments with graduate programs should look carefully at the overall balance, not at course offerings but at goals. The ultimate object of the game must be the service of man.—ESL

07643 **Bayne, Charles K.** Evidence of multiple stades in the lower Pleistocene of northeastern Kansas: Kansas Acad. Sci. Trans., v. 71, no. 3, p. 340-349, illus., 1968.

Nebraskan and Kansan glaciofluvial deposits in northeastern Kansas were recently exposed in Doniphan and Atchison Counties in preglacial bedrock channels. Distinctive features permit correlation of six measured sections, showing twofold division of the Nebraskan Glacial Stage, and two Kansan Stades. Most easily recognized is interglacial Afton soil, near top of noncalcareous Nebraskan lake deposits (Unit 3). Unit 1, basal gravel of chert and limestone with glacial erratics, lies on Pennsylvanian shale; interbedded Unit 2 has a weak interstadial soil near top; above the Afton is Unit 4, the blue-gray, calcareous Nickerson Till with dominantly local erratics; Unit 5, distorted interstadial outwash, incorporates blocks of the underlying till; Unit 6, the Cedar Bluff Till, late medial Kansan, is clayey, silty boulder till.—GDC

Bayne, Charles K. *See* Jewett, John Mark. 07665

Beckman, Walter A., Jr. *See* Whitten, E. H. Timothy. 02282

Beene, Douglas L. *See* Oros, Margaret O. 07664

02040 **Beer, Avery S.** Petrology and structure of the Ragged Mountain pluton, Gunnison County, Colorado [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 6-7, 1969.

Behrendt, J. C. *See* Tibbetts, B. L. 02292

07532 **Behrendt, John C.; Tibbetts, Benton L.; Bonini, William E.; Lavin, Peter M.** A geophysical study in Grand Teton National Park and vicinity, Teton County, Wyoming: U.S. Geol. Survey Prof. Paper 516-E, p. E1-E23, illus., tables, geol. map, 1968.

An integrated geophysical study was made over 4,600 km² in Grand Teton National Park and vicinity, Wyoming. Bouguer anomalies range from -185 mgal over Precambrian rocks of the Teton Range to -240 mgal over low-density Tertiary and Cretaceous sedimentary rocks of Jackson Hole. A seismic-refraction model has velocities of 2.45 km per sec for the Tertiary and Cretaceous rocks above the Cloverly Formation, 3.9 km per sec for the lower Mesozoic rocks, and 6.1 km per sec for the Paleozoic (limestone and dolomite) and Precambrian rocks. The Teton Range has a maximum vertical uplift of about 7 km, as inferred from the maximum depth to basement of about 5 km. Aeromagnetic data show anomalies in the Teton and Gros Ventre Ranges which are caused mainly by layered Precambrian gneisses. —JCB

Behunin, H. *See* Tidwell, W. D. 02216

07510 **Bell, Gordon L.** Engineering geology of Interstate Highway 94 underpass at Northern Pacific Railway, Fargo, North Dakota: Geol. Soc. America Eng. Geology Case Histories, no. 6, p. 49-53, illus., table, 1968.

Exploration drilling of 11 test holes showed as much as 78 feet of "quicksand" under the highway construction site, from an abandoned stream channel within sediments of ancient Lake Agassiz. Well points, verticals and drains, and special filter-sand-encased subdrains discharging into a lift station were required during excavation. The concrete pavement has remained stable under constant use since 1960. This is an example of the use of well points in stabilizing saturated soils for highway construction.—*from* Author's abstract

02443 **Bence, A. E.; Burnett, D. S.** Chemistry and mineralogy of the silicates and metal of the Kodaikanal meteorite: Geochim. et Cosmochim. Acta, v. 33, no. 3, p. 387-407, illus., tables, 1969.

A chemical and mineralogical study of silicate and metal phases of Kodaikanal has been made by optical, X-ray, and electron microprobetechniques. Silicate inclusions are mineralogically inhomogeneous and consist of either compositionally homogeneous alkali feldspathic glass or crystalline alkali feldspar and clinopyroxene in varying proportions with orthopyroxene as a minor constituent. Evidence indicates that the silicate was cooled rapidly from a relatively high temperature, and that the silicates equilibrated under low pressures. Textures of the metal and metal-silicate interfaces show evidence of intense deformation. Examination of the Widmanstätten pattern in relatively undeformed areas gives a cooling rate which is much faster than for most other iron meteorites. The restrictions placed on possible evolutionary histories by both the present and previous data are discussed.—*from* Authors' abstract

02304 **Bennett, G.; Thurston, P. C.; Giguere, J. F.** Operation Pukaskwa-Pukaskwa River sheet, Districts of Thunder Bay and Algoma: Ontario Dept. Mines Prelim. Geol. Map P. 506, scale 1 in. to 1/4 mi., text, 1969.

02305 **Bennett, G.; Thurston, P. C.; Thurston, J. F.; Giguere, J. F.** Operation Pukaskwa–University River sheet, Districts of Thunder Bay and Algoma: Ontario Dept. Mines Prelim. Geol. Map P. 507, scale 1 in. to 1 mi., text, 1969.

02319 **Bennett, G.; Thurston, P.; Giguere, J. F.** Operation Pukaskwa, Districts of Algoma and Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 541, scale 1 in. to 2 mi., 1969.

02570 **Bennett, G.; Brown, D. D.; George, P. T.; Leahy, E. J.** Hearst-Kapuskasing sheet (geological compilation series), Algoma and Cochrane Districts: Ontario Dept. Mines Map 2166, scale 1:253,440, text, 1969.

The map area contains deposits of gold, iron, kaolin, lithium, and silica; there has been no production other than test shipments.—MCM

Berg, Eduard. *See* Gedney, Larry. 02352

Berry, L. G. *See* Radcliff, Dennis. 07542

02260 **Bertmar, Gunnar.** The vertebrate nose, remarks on its structural and functional adaptation and evolution: Evolution, v. 23, no. 1, p. 131-152, illus., 1969.

Important structural adaptations of the nasal sac, as well as development of the nasal and choanal tubes, nostrils, and choanae, were analyzed all together in fossil and extant fishes and lower tetrapods, to trace the structural and functional evolution of the vertebrate nose. In the several favored pathways of adaptation of olfactory folds, either the olfactory or circulatory function usually dominates. The naso-buccal groove has evolved by convergence—from the nasal groove in dipnoans, Holocephali, and some elasmobranchs; from the posteroventral accessory nasal sac in rhipidistians. Evolution of the choanal tube in tetrapods was analyzed; presence of a choana should no longer be considered a character of first rank in vertebrate tax-

onomy, as the choana may have evolved not only in crossopterygians but also in some actinopterygians, which cannot be considered tetrapod ancestors.—VMJ

02041 **Best, M. G.** Mesozoic(?) orogenic activity in the Kern Mountains, eastern White Pine County, Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 7, 1969.

02399 **Beus, Alexei A.** Geochemical criteria for assessment of the mineral potential of igneous rock series during reconnaissance exploration, *in* International geochemical exploration symposium: Colorado School Mines Quart., v. 64, no. 1, p. 67-74, tables, 1969.

A table illustrates the niobium pentoxide distribution in muscovite from pegmatites of columbite-bearing and barren fields of the United States. The geochemical criteria for determination of parent granites of the rare metals (Li, Be, Sn, W, Ta, Nb) deposits and of parent granites of tungsten, tin, and tantalum deposits are tabulated also.—KAF

02042 **Beutner, Edward C.** Reverse gravitative movement on earlier overthrusts, Lemhi Range, Idaho [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 8, 1969.

07675 **Bhatnagar, Vijay Mohan.** The mineral lead apatites: Soc. Française Mineralogie et Cristallographie Bull., v. 91, no. 5, p. 479-486, illus., tables, 1968.

Some aspects of the pyromorphites are outlined. The XO_4^{3-} group in lead apatites has lower symmetry than the undistorted ion. The replacement of Ca^{++} by Pb^{++} causes frequencies shift of ν_3 and ν_1 vibrations.—Author's abstract

02278 **Bicker, Alvin R., Jr.** Copiah County geology, *in* Copiah County geology and mineral resources: Mississippi Geol., Econ. and Topog. Survey Bull. 110, p. 11-62, illus., tables, geol. map, 1969.

Copiah County in south-central Mississippi is in the Gulf Coastal Plain province. Geologic units exposed at the surface are parts of the Miocene, Pleistocene, and Recent series; oldest unit exposed is the Catahoula Formation. Other units in ascending order are: Miocene Hattiesburg Formation, Pleistocene Citronelle Formation, stream terraces, and loess; and Recent stream terrace and alluvium. Near surface beds show southward regional dip, several anticlinal structures are apparent in the western part, and five shallow piercement type salt domes are present. Surface rocks and minerals of economic importance include clay and natural clay mixtures for brick and tile, and sand and gravel for road building and the construction industry. Salt production is a possibility.—*from* Author's abstract

Bidwell, L. E. *See* Maclay, R. W. 02329

07691 **Binda, P. L.** New species of *Spermatites* from the Upper Cretaceous of southern Alberta [with French abs.]: Rev. Micropaleontologie, v. 11, no. 3, p. 137-142, illus., 1968.

Two new species and a new subspecies of *Spermatites* Miner 1935, a form-genus for fossil seeds of uncertain affinity, are described from the shaly beds of the "White Sandstone" horizon of the middle Edmonton Formation: *S. minimus*, *S. piperiformis*, *S. ellipticus minor*. Miner (1935) described seven new species of *Spermatites* but did not designate a type species or select holotypes; *S. ellipticus* Miner1935 is proposed as type species, and lectotypes are chosen for Miner's seven species. Length to width ratio is plotted against length for 46 specimens of Binda's new taxa; size data given by Miner (1935) for five species are plotted for comparison. The fossil seeds show affinity to the extant monocot genus *Juncus*, but the form-generic name is retained until confirming evidence is found.—VMJ

02191 **Bischoff, James L.** Temperature controls on aragonite-calcite transformation in aqueous solution: Am. Mineralogist, v. 54, nos. 1-2, p. 149-155, illus., 1969.

The fraction of aragonite transformed to calcite at 50-120°C is proportional to square of reaction time, indicating control by nucleation and growth of calcite. The rate constant decreases with temperature corresponding to an activation energy 57.4 kcal/mole, and can be interpreted in terms of a loosely hydrated calcium bicarbonate ion-pair. The activation energy agrees with earlier work by Taft and Metzger and Barnard, but the absolute rates are apparently a function of specific experimental conditions.—Author's abstract

02400 **Blackburn, W. H.** Zoned and unzoned garnets from the Grenville gneisses around Gananoque, Ontario: Canadian Mineralogist, v. 9, pt. 5, p. 691-698, illus., tables, 1969.

Strict limitations are placed on reacting chemical systems during metamorphism if one or more of the mineral phases is compositionally zoned. An investigation of the volumes of equilibrium in some high-grade metamorphic rocks from the Grenville of southeastern Ontario, therefore, included a study of possible zoning of the garnets. Traverses at 25 micron steps across four garnets, employing a laser-excited spectrochemical technique, revealed no compositional zoning with respect to Fe, Mg, Mn or Ca in three of the grains. High Mn values, however, occur in the central portion of one garnet within an area of quartz inclusions. It is proposed that the garnets of these rocks were originally zoned and that later metamorphic events have eliminated this zoning in most of the garnets, some still showing a relic zoning in their central portions.—Author's abstract

02557 **Blacut, Gustavo; Kleinpell, R. M.** A stratigraphic sequence of benthonic smaller Foraminifera from the La Boca Formation, Panama Canal Zone: Cushman Found. Foram. Research Contr., v. 20, pt. 1, p. 1-22, illus., 1969.

More than 60 species and varieties of benthonic foraminifers are described briefly from the early Miocene La Boca Formation at the type locality of *Siphogenerina transversa* Cushman, 1918, for comparison with California Coast Range benthonic species, and correlation of the La Boca with other stratigraphic sequences bearing *S. transversa*, and with planktonic foraminiferal zones. The Panama material is from 19 samples of a 425-ft-thick section of the La Boca from an exposure in a canal cut and from a nearby core hole. West Coast Range faunas show close affinities resulting from invasions from the Caribbean in Eocene, Oligo-Miocene, and early Miocene times; the La Boca fauna falls within the Saucesian Stage, which immediately preceded the provincialization and endemic evolution of the middle Miocene benthonic faunas in California.—VMJ

02175 **Blair, Graeme J.; Crofts, F. C.** A quantitative and radioactive sulfur (S^{35}) liquid scintillation counting method for determining soil and plant sulfur: Soil Sci., v. 107, no. 4, p. 277-280, illus., tables, 1969.

A method for counting S-35 present as sulfate or total S in soil and plant material is presented. The procedure reduces the plant or soil sulfur to H_2S and adsorption in NaOH, an aliquot of which is mixed with a dioxane-based scintillation phosphor and counted in a liquid scintillation counter with an efficiency greater than 90 percent.—JWH

02043 **Blake, M. C., Jr.; Hose, R. K.; McKee, E. H.** Tertiary volcanic stratigraphy of White Pine County, Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 8, 1969.

Blake, M. C., Jr. *See* Hose, Richard K. 02087

07693 **Blanc, Robert P.; Cleveland, George B.** Natural slope stability as related to geology, San Clemente area, Orange and San Diego Counties, California: California Div. Mines and Geology Spec. Rept. 98, 19 p., illus., geol. map, 1968.

The San Clemente area lies in the path of urban development in low rolling hills inland from the coast. Most widely distributed rocks are shale and mudstone of the Miocene Monterey Formation, and mudstone of the Miocene-Pliocene Capistrano Formation; they are separated in the northeast corner of the area from sandstone of

the Eocene Santiago Formation by the Christianitos fault. During Pleistocene time an extensive terrace developed along the coast on which the city has been built. A combination of adverse geologic features and processes has led to widespread landsliding. Analysis of the origin of the landslides, which can be traced to rock type and structural and geomorphic factors, provides a means of predicting natural stability of all slopes. These factors have been integrated and displayed on a map which shows the range of natural slope stability.—*from* Authors' abstract

07527 **Blanchard, Frank N.; Denahan, Stephen A.** Cacoxenite and beraunite from Florida: Am. Mineralogist, v. 53, nos. 11-12, p. 2096-2101, illus., 1968.

Cacoxenite and beraunite, two hydrated iron phosphates resulting from weathering of certain phosphatic sediments, occur associated with quartz, wavellite, and goethite as constituents of irregularly-shaped nodules in the overburden of unconsolidated sediments of the Pliocene Bone Valley Formation at the Palmetto mine, southwest of Bartow, Polk County, Florida. Identification is based on optical properties, X-ray powder diffraction data, and differential thermal analysis.—MEM

Blatt, Harvey. *See* Cameron, Kenneth L. 02129

07616 **Blume, Helmut.** Zur Problematik des Schichtstufenreliefs auf den Antillen [with English, French, and Russian summ.]: Geol. Rundschau, v. 58, no. 1, p. 82-97, illus., 1968.

The tectonic and petrographic conditions for development of cuesta landscapes are fulfilled in several localities in the Greater and Lesser Antilles. In addition, the climatic variations are extremely great, and the transition from humid to arid conditions takes place within small distances. Three cuestas are analyzed—the Lares-Utuado in Puerto Rico, in a very humid region; the coral limestone on Bonaire, in an arid region; and the coral limestone on Barbados, in semihumid and humid areas. The analysis provides a better understanding of the effect of climate on the development of cuestas and gives some clues to climatic changes since Pleistocene time.—DBV

02483 **Boettcher, A. L.; Wyllie, P. J.** The system CaO-SiO_2-CO_2-H_2O—[Pt.] 3, Second critical end-point on the melting curve: Geochim. et Cosmochim. Acta, v. 33, no. 5, p. 611-632, illus., table, 1969.

Melting relationships in this system have been extended to 40 kbar pressure. Dellaite, dicalcium silicate, spurrite, and calciochondrodite appear as the silicate phases coexisting with vapor-saturated liquids and fluids at high pressures. Wollastonite does not appear on the vapor-saturated liquidus. The solidus terminates at a second critical end-point at about 32.5 kbar and 515°C. Phase relationships in a hypothetical ternary system with critical end-points are developed. An extension of these relationships into the system shows that a critical curve limiting the miscibility gap between liquids and vapors moves through the system with changing pressure, terminating a series of univariant reactions at critical end-points. The results illustrate that fractional crystallization in this system will produce carbonatitic melts only from liquids originally undersaturated in silica.—*from* Authors' abstract

02373 **Bolt, Bruce A.** Earthquakes and the structural features of northern California [summ.]: California Div. Mines and Geology Mineral Inf. Service, v. 22, no. 4, p. 51-54, illus., 1969; full paper originally published 1968.

The complete paper by Bolt, Lomnitz, and McEvilly, "Seismological evidence on the tectonics of central and northern California and the Mendocino escarpment," appeared in Seismol. Soc. America Bull., v. 58, no. 6, p. 1725-1767, illus., tables, 1968. *See* Abstracts of North America Geology for May 1969.—GDC

Bonini, William E. *See* Behrendt, John C. 07532

02193 **Borg, I. Y.; Smith, D. K.** Calculated powder patterns—Pt. 2, Six potassium feldspars and barium feldspar: Am. Mineralogist, v. 54, nos. 1-2, p. 163-181, illus., tables, 1969.

Integrated (I_{INT}) and peak (I_{PK}) intensities are calculated from single-crystal structure analyses for maximum microcline (granitic and authigenic), intermediate microcline, orthoclase, adularia, high sanidine and celsian. Graphical representation of the intensities distributed over Cauchy profiles results in plots which are very similar to comparable experimental X-ray diffraction traces over the whole 2θ range. Apparent differences in peak heights in the calculated and experimental patterns can be related to preferred orientations of crystals in standard mounts because of cleavage production during grinding.—Authors' abstract

07540 **Borg, I. Y.; Smith, D. K.** Calculated powder patterns—[Pt.] 1, Five plagioclases: Am. Mineralogist, v. 53, nos. 9-10, p. 1709-1723, illus., tables, 1968.

As an aid in indexing complex plagioclase X-ray powder patterns, integrated and peak intensities are calculated for five plagioclases [low and high albite (An_0), oligoclase (An_{29}), bytownite (An_{80}), and anorthite (An_{100})]. Lorentz-polarization, absorption and multiplicity corrections appropriate to powder amounts are applied to temperature-corrected $|F|^2$ which are calculated from single-crystal structure analyses. Graphical expression of I_p as a function of 2θ results in plots which are very similar to the comparable experimental X-ray diffraction traces.—Authors' abstract

Botbol, J. M. *See* McCarthy, J. H., Jr. 02466

02186 **Bowen, L. H.; Weed, S. B.; Stevens, J. G.** Mössbauer study of micas and their potassium-depleted products: Am. Mineralogist, v. 54, nos. 1-2, p. 72-84, illus., tables, 1969.

The Mössbauer spectrum of iron in both dioctahedral and trioctahedral micas can be used to determine nondestructively the ferrous and ferric iron content. Variations in isomer shift and quadrupole splitting among the micas have been correlated with chemical and structural variations. The Mössbauer spectra of potassium-depleted micas are characteristic of the parent structure, except for changes in oxidation state.—Authors' abstract

Bowes, D. R. *See* Skinner, William R. 02266

02486 **Brabb, Earl E.** Eocene Colloquium: Geotimes, v. 14, no. 3, p. 19-20, illus., 1969.

The area of greatest progress during this Soc. Geol. France colloquium of 1968, held in France, Belgium, England, and Italy, was the rebirth of effective communication between scientists of many different countries. The written record will include 3 volumes of Proceedings, 5 guidebooks, and informal communications. Proposed, in brief: no new stages without opinion of I.U.G.S. Stratig. Comm.; file examples of new species, particularly plantonic microfossils, in the 10 principal museums of the world; redefine Ilerdian, Biarritzian, and Priaronian Stages; re-examine European Eocene Stages, with some new reference sections; define base of a Tertiary series by base of oldest stage within it. Frameworks for Paleocene-Eocene and Eocene Oligocene boundaries, two charts, include the Gulf and Pacific coasts of U.S.A.—GDC

Brandenberger, F. *See* Haefeli, R. 07699

02489 **Bredehoeft, John D.** Finite difference approximations to the equations of groundwater flow: Water Resources Research, v. 5, no. 2, p. 531-534, illus., 1969.

Stallman's method, based upon a finite difference approximation to the equation of steady flow in a heterogeneous isotropic aquifer, and Samuel's attempts to apply it to electric analog models are reviewed. The question is raised as to how to model the situation in which the principal axes of the transmissibility tensor change orientation, and whether there is an analogy in the resistor network for this problem.—ESL

02044 **Breed, Carol S.** A century of hypotheses on the origin of the ColoradoRiver [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 9, 1969.

Breed, William J. *See* Ford, Trevor D. 02131

Bremner, J. M. *See* Keeney, D. R. 02297

Brett, George W. *See* Weld, Betsy A. 02355

02254 **Brew, David A.; Ford, A. B.** Boundary Creek molybdenum-silver occurrence, *in* Some shorter mineral resource investigations in Alaska: U.S. Geol. Survey Circ. 615, p. 12-15, illus., table, 1969.

Two molybdenite occurrences with local anomalous concentrations of silver were found in a dike-like body of iron-stained granodiorite and aplite; the body is more than 2 miles long and at least 2,000 feet thick. The Tertiary(?) granodiorite-aplite body cuts tonalite and related rocks of Cretaceous(?) age approximately 10 miles north of the Taku River and 5 miles west of the United States-Canadian border.—Authors' abstract

Brewer, Peter G. *See* Spencer, Derek W. 02501

Bricker, Owen P. *See* Wollast, Roland. 07536

Bridges, B. L. *See* Holland, J. L. 02086

02061 **Brimhall, Willis H.** Rapid analysis of basaltic rocks by atomic absorption spectrophotometry [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 9-10, 1969.

02128 **Brimhall, Willis H.** Measurement of Pb-206, Pb-207 and Pb-208 by means of differential atomic absorption [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 9, 1969.

07656 **British Columbia Water Res. Service.** Groundwater levels in observation wells to December 1967, Province of British Columbia: Victoria, B.C., British Columbia Water Resources Services, Water Inv. Br., 110 p., illus., tables, 1968.

The ground-water observation wells network in British Columbia was established in 1961; extension of the network has continued since that time. Well descriptions and water-level measurements are tabulated for coastal watershed, Fraser watershed and lower mainland, Okanagan-Similkameen watershed, and Columbia watershed. Locations of observation wells are shown on two maps.—MCM

02479 **Brooks, C. Kent.** On the distribution of zirconium and hafnium in the Skaergaard intrusion, East Greenland: Geochim. et Cosmochim. Acta, v. 33, no. 3, p. 357-374, illus., tables, 1969.

Twenty-five determinations of Zr and 11 of Hf, together with a number of analyses of separated minerals, are reported for a series of representative samples from the Skaergaard intrusion. These show that in the successive residual liquids there was a marked increase in both the Zr and Hf concentrations, together with a slight but significant rise in the Zr/Hf ratio, similar to that normally found in alkaline rocks. This is attributed to a very low state of polymerization in these liquids, caused principally by a build-up of volatiles as crystallization proceeded, and also their characteristic chemical constitution.—Author's abstract

07628 **Brooks, Howard C.; Ramp, Len.** Gold and silver in Oregon: Oregon Dept. Geology and Mineral Industries Bull. 61, 337 p., illus., tables, 1968.

Gold mining, the primary reason for early settlement and growth of Oregon, is no longer a major activity due primarily to the price of gold and to increasing costs of mining. This compendium of known information on gold and silver in the state is divided into three parts: (1) general discussion—introduction, economics of gold and silver, Oregon's gold and silver industry, occurrence of gold and silver, and mining methods and treatment; (2) deposits in eastern Oregon—gold belt of the Blue Mountains, and isolated districts; and (3) deposits in western Oregon—Klamath Mts. and Western Cascades. A bibliography and an index of mines is appended.—MCM

07615 **Brown, A. Sutherland.** Geology of the Queen Charlotte Islands, British Columbia: British Columbia Dept. Mines and Petroleum Resources Bull. 54, 226 p., illus., tables, geol. maps, 1968.

Land area of the Queen Charlotte Islands, about 3,840 sq mi, is divided into the Queen Charlotte Ranges, Skidegate Plateau, and Queen Charlotte Lowlands; in the Pleistocene, the islands were intensively glaciated. Fundamental structural unit is a thick, Late Triassic pillowed basalt, separated by a flysch-like Triassic-Jurassic sequence from an explosive Jurassic andesite and largely marine deposition. Two Cretaceous sedimentary units are successively less involved in deformation. A final Tertiary period deposited 18,000 feet of intercalated flood basalts and sodic rhyolite ash flows which are gently warped, eroded, and overlain by up to 6,000 feet of Mio-Pliocene sand and shale. Crustal fracturing has been the dominant mechanism of deformation, controlling volcanism, sedimentation, intrusion, and secondary folding. Mineral resources, especially iron-copper deposits, are extensive.—*from* Author's abstract

Brown, D. D. *See* Bennett, G. 02570

07593 **Brown, Donald L.** Geologic map of the Masseyville quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 12A-SW, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Masseyville quadrangle, Tennessee," by C. R. Sykes, is cited separately.—MCM

07594 **Brown, Donald L.** Geologic map of the Henderson quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 12A-NW, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Henderson quadrangle, Tennessee," by C. R. Sykes is cited separately.—MCM

07601 **Brown, Donald L.** Geologic map of the Luray quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 446-SE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Luray quadrangle, Tennessee," by C. R. Sykes is cited separately.—MCM

02189 **Brown, G. E.; Gibbs, G. V.** Refinement of the crystal structure of osumilite: Am. Mineralogist, v. 54, nos. 1-2, p. 101-116, illus., tables, 1969.

The crystal structure was refined to $R = 0.066$ using a Weissenberg counter diffractometer. Mean T1-O (1.627[2] A) and T2-O (1.762[2] A) bond lengths indicate that 10.22 Si plus 1.78 Al are restricted to the 12 tetrahedra in the double hexagonal rings and that 2.63 Al plus 0.37 Fe^{3+} occupy the three tetrahedra outside the rings. Edges shared between the latter and octahedra are shorter than unshared ones. K, Ca, Na atoms are coordinated between double six-membered rings in a hexagonal antiprism which shares an edge with the tetrahedron. Water is randomly distributed within each cavity formed by double hexagonal rings in one of six symmetrically identical positions. A short H_2O-O distance of 2.6[1] A indicates hydrogen bonding between H_2O and cavity-wall oxygens. Osumilite is classified with framework silicates.—*from* Authors' abstract

02497 **Brown, Robert J. S.** Normal-moveout and velocity relations for flat and dipping beds and for long offsets: Geophysics, v. 34, no. 2, p. 180-196, illus., 1969.

Accurate relations between normal-moveout (NMO) and velocity are needed in modern exploration seismology, especially in long-offset common-depth-point (CDP) work where accurate NMO corrections must be made for stacking, and where several types of velocity averages may be computed with accuracy from NMO data. The relation between NMO and velocity depends on the dip of the reflector. Conditions are now encountered which require that the reflector dip be known in order to achieve the best stack of CDP traces or to obtain accurate velocity information. Some corrections to the usual NMO-velocity relations are given, and a criterion is developed for the accuracy required for NMO in CDP stacking.—DBV

02062 **Brown, William T., Jr.; Kudo, Albert M.** Inclusions of ultramafic and sedimentary rocks in volcanic necks, Sandoval and Valencia Counties, New Mexico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 10, 1969.

02063 **Budge, David R.** Late Ordovician and Silurian coral communities, eastern Great Basin [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 10-11, 1969.

Bunch, T. E. *See* Snetsinger, Kenneth G. 07552

02202 **Bunch, Theodore E.; Fuchs, Louis H.** Yagiite, a new sodium-magnesium analogue of osumilite: Am. Mineralogist, v. 54, nos. 1-2, p. 14-18, tables, 1969.

Yagiite, a new osumilite-type sodium-magnesium-aluminum silicate is found in silicate inclusions of the *Colomera* iron meteorite associated with aluminous titanian diopside, whitlockite, tridymite and plagioclase. It is colorless, uniaxial positive, and weakly pleochroic; refractive indices are $\epsilon = 1.544$, $\omega = 1.536$. Average composition is SiO_2 61.7; Al_2O_3 19.1; Cr_2O_3 0.1; TiO_2 0.8; FeO 2.4; MgO 10.5; MnO 0.2; CaO 0.1; Na_2O 3.7 and K_2O 1.4, sum 100.0 wt percent. X-ray data show that yagiite is isostructural with osumilite; unit cell dimensions are $a = 10.09 \pm 0.01$ A, $c = 14.20 \pm 0.03$ A. Strongest X-ray lines are: 3.228 (100), 5.059 (65), 3.726 (50). Calculated density is 2.70 g/cm^3.—*from* Authors' abstract

Burnett, D. S. *See* Bence, A. E. 02443

02064 **Bushman, Jess R.** Palynology of the Spotten Cave Archaeological Site, Santaquin, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 11, 1969.

Butterfield, David. *See* Hodges, Arthur L., Jr. 07621

Butterfield, David. *See* Hodges, Arthur L., Jr. 07622

Butterfield, David. *See* Hodges, Arthur L., Jr. 07623

Butterfield, David. *See* Hodges, Arthur L., Jr. 07624

02065 **Buttgereit, Charles D.** Residual analysis of potential field data over structures in Utah and Colorado [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 11-12, 1969.

02470 **California Dept. Water Resources.** Ground water quality, App. E *in* Hydrologic data, 1967—V. 5, Southern California: California Dept. Water Resources Bull. 130-67, v. 5, app. D-F, p. 59-173, illus., tables, 1969.

Data from approximately 2,000 wells are tabulated for mineral and trace-element analyses of ground water in the six drainage provinces of southern California.—MCM

02129 **Cameron, Kenneth L.; Blatt, Harvey.** Interpretive petrology of stream sediment, Elk Creek, Black Hills, South Dakota [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 12, 1969.

02152 **Canada Geological Survey.** Geology, Beaverlodge mining area, Saskatchewan: Canada Geol. Survey Prelim. Ser. Map 27-1968, 2 sheets, scale 1:14,400, 1969.

02405 **Canada Geological Survey.** Geological maps published by the Geological Survey of Canada—Index Sheet 11, Nova Scotia-Newfoundland-Prince Edward Island: Ottawa, Ontario, Geol. Survey Canada, scale 1:1,000,000, revised 1969.

02409 **Canada Geological Survey.** Geological maps published by the Geological Survey of Canada—Index Sheet 21, New Brunswick-Quebec-Nova Scotia-Prince Edward Island: Ottawa, Ontario, Geol. Survey Canada, scale 1:1,000,000, revised 1969.

02410 **Canada Geological Survey.** Geological maps published by the Geological Survey of Canada—Index Sheet 32, Quebec-Ontario: Ottawa, Ontario, Geol. Survey Canada, scale 1:1,000,000, revised 1969.

02411 **Canada Geological Survey.** Geological maps published by the Geological Survey of Canada—Index Sheet 41, Ontario: Ottawa, Ontario, Geol. Survey Canada, scale 1:1,000,000, revised 1969.

02412 **Canada Geological Survey.** Geological maps published by the Geological Survey of Canada—Index Sheet 52, Ontario-Manitoba: Ottawa, Ontario, Geol. Survey Canada, scale 1:1,000,000, revised 1969.

02413 **Canada Geological Survey.** Geological maps published by the Geological Survey of Canada—Index Sheet 84, Alberta: Ottawa, Ontario, Geol. Survey Canada, scale 1:1,000,000, revised 1969.

02414 **Canada Geological Survey.** Geological maps published by the Geological Survey of Canada—Index Sheet 95, Yukon Territory-District of Mackenzie: Ottawa, Ontario, Geol. Survey Canada, scale 1:1,000,000, revised 1969.

02472 **Canada Geological Survey.** Aeromagnetic series, Edmundston, New Brunswick (2d edition): Canada Geol. Survey Geophysics Paper 7070, scale 1:253,440, revised 1969; originally published 1965.

02473 **Canada Geological Survey.** Aeromagnetic series, Rimouski, Quebec: Canada Geol. Survey Geophysics Paper 7079, scale 1:253,440, 1969.

02474 **Canada Geological Survey.** Aeromagnetic series, Baie-Comeau, Quebec: Canada Geol. Survey Geophysics Paper 7093, scale 1:253,440, 1969.

02475 **Canada Geological Survey.** Aeromagnetic series, Gaspé, Quebec-New Brunswick: Canada Geol. Survey Geophysics Paper 7345, scale 1:253,440, 1969.

02476 **Canada Geological Survey.** Aeromagnetic series, Matane, Quebec-New Brunswick: Canada Geol. Survey Geophysics Paper 7346, scale 1:253,440, 1969.

02477 **Canada Geological Survey.** Aeromagnetic series, Port-Menier, Quebec: Canada Geol. Survey Geophysics Paper 7353, scale 1:253,440, 1969.

02478 **Canada Geological Survey.** Aeromagnetic series, Cap-Chat, Quebec: Canada Geol. Survey Geophysics Paper 7354, scale 1:253,440, 1969.

Carlson, E. H. *See* Eakins, P. R. 07689

Carlson, R. C. *See* Hearst, J. R. 02498

02519 **Carpenter, Robert H.; Fagan, James M.** Barite nodules in the Athens Shale in northeastern Tennessee and southwest Virginia: Southeastern Geology, v. 10, no. 1, p. 17-29, illus., tables, 1969.

Spheroidal to ellipsoidal barite nodules have been identified in carbonaceous beds at seven localities. They vary from less than 0.5 inches to more than a foot in diameter, and typically contain barite crystals up to 1.0 mm in size disseminated in a black shale matrix, with pyrite. These nodules are comparable with occurrences on the Pacific Ocean floor, coincident with prominent faults and formed during diagenesis by interaction of ascending barium chloride solutions with sulfate-bearing interstitial sea water. Solutions traversing the Shady and Knox Dolomites may have deposited the concentrations of epigenetic barite in these formations, simultaneously with the diagenetic formation of the nodules in the muds of the Athens Shale. This widespread distribution is interpreted as indicating regional hydrothermal activity.—*from* Authors' abstract

07526 **Carr, R. M.** The problem of quartz-corundum stability: Am. Mineralogist, v. 53, nos. 11-12, p. 2092-2095, illus., 1968.

Hydrothermal synthesis with amorphous aluminosilicate starting material produces quartz + corundum over the range 2 to 5 kbar and 560-750°C. Crystalline aluminosil-

icates do not yield quartz + corundum. The author concludes that quartz + corundum are incompatible under geologic conditions.—JSH

Carstea, D. D. *See* Harward, M. E. 02379

Cervione, Michael A., Jr. *See* Thomas, Chester E., Jr. 07642

07682 **Chadwick, Robert A.** Geologic and paleomagnetic relationships in the Gallatin Range and adjacent Yellowstone Valley, *in* Structures and origin of volcanic rocks, Montana-Wyoming-Idaho—Natl. Sci. Found. Summer Field Course 1968, Guidebook: Detroit, Mich., Wayne State Univ., p. 45-48, illus., revised 1968; originally published 1965.

Interpretation of geology in this area has been revised in light of paleomagnetic studies and mapping since 1965. The Eocene volcanics of Gallatin Range, occurring as andesitic flows, andesitic flow breccias, mudflow and fluvial breccias, and vent deposits, probably total more than 6,000 feet, with individual flows up to 200 feet thick. Paleomagnetic studies in the Point of Rocks vent complex distinguish high-temperature breccias, with magnetic dipoles of the fragments alined, from low-temperature types, with dipoles scattered, and interpret their emplacement. In Yellowstone Valley, two sets of Pliocene basalt flows are distinguished by opposite magnetic polarity. A large landslide and mudflow of breccia from Sepulchre Mountain into the valley was originally mapped in error as glacial moraine.—VMJ

02107 **Chakrabarti, Ananda K.** Geology of the Trade Lake area, Saskatchewan, Canada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 12-13, 1969.

Chang, Luke L. Y. *See* Hill, V. G. 07547

02299 **Chapman, S. L.; Syers, J. K.; Jackson, M. L.** Quantitative determination of quartz in soils, sediments, and rocks by pyrosulfate fusion and hydrofluosilicic acid treatment: Soil Sci., v. 107, no. 5, p. 348-355, illus., tables, 1969.

Quartz plus feldspar in soils, sediments, and rocks may be isolated and the amount determined quantitatively, following fusion of the sample with sodium pyrosulfate. Treatment of the residue with H_2SiF_6 removed feldspars completely, allowing a quantitative determination of quartz.—JWH

07557 **Chappell, B. W.; White, J. R.** The X-ray spectrographic determination of sulfur coordination in scapolite: Am. Mineralogist, v. 53, nos. 9-10, p. 1735-1738, table, 1968.

X-ray emission spectra show that sulfur coordination in scapolite is tetrahedral indicating the presence of SO_4^{2-} radicals.—MR

Charm, Walter B. *See* Lidz, Louis. 02363

Charmatz, Richard. *See* Ellis, Brooks F. 02328

Cheney, Eric S. *See* Lange, Ian M. 02070

02108 **Chesser, William L.** Classification of morphological features in the Grand Canyon, Arizona [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 13, 1969.

02195 **Christ, C. L.; Hathaway, J. C.; Hostetler, P. B.; Shepard, Anna O.** Palygorskite—New X-ray data: Am. Mineralogist, v. 54, nos. 1-2, p. 198-205, illus., tables, 1969.

Analysis of X-ray diffraction powder data for five palygorskite samples shows that three of the samples are orthorhombic and two are monoclinic. Retaining the same cell setting for all palygorskites, in one of the monoclinic samples the unique axis is *b*, and in the other, is *a*. Unit-cell parameters are in agreement with the values given in

the literature. For both the monoclinic and the orthorhombic minerals systematic extinctions in *hkl* reflections lead to a primitive cell with an *n*-glide on (001), consistent with the projected structure of Bradley (1940). Data in the literature are in general agreement with the symmetry results of the present study.—Authors' abstract

Christiansen, Robert L. *See* Lipman, Peter W. 02204

Clark, Allen L. *See* Hawley, C. C. 02458

02109 **Clark, Bruce R.** The origin of slaty cleavage in the Coeur d'Alene district, Idaho [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 13-14, 1969.

Clark, Joan R. *See* Finney, J. J. 02469

Clark, Sandra H. A. *See* Hawley, C. C. 02458

Clark, Sandra H. B. *See* Foster, Helen L. 02092

02110 **Clark, Sandra H. B.** Structural analysis of high-grade Precambrian metamorphic rocks in the Priest River-Hoodoo Valley area, northern Idaho [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 14-15, 1969.

02252 **Clark, Sandra H. B.; Condon, W. H.; Foster, Helen L.; Hoare, J. M.** Geochemical data in the Sikonsina Pass area, *in* Some shorter mineral resource investigations in Alaska: U.S. Geol. Survey Circ. 615, p. 21-25, illus., tables, 1969.

Anomalous concentrations of lead, gold, copper, and molybdenum were detected locally in analyses of stream-sediment samples from the Sikonsina Pass area. Only two bedrock samples were analyzed; one sample contained about 1 percent copper, and the other contained 3 ppm silver. The area is mainly underlain by metasedimentary rocks of Paleozoic(?) age.—Authors' abstract

07667 **Clarke, Otis M., Jr.** Clays of southeastern Alabama: Alabama Geol. Survey Circ. 20-D, 91 p., illus., tables, geol. map, 1968.

Southeastern Alabama is underlain by unconsolidated, predominantly marine sediments ranging in age from Upper Cretaceous to Miocene. In the east, formations dip toward the Atlantic slope, and in the central and western part, toward the Gulf Embayment. Facies changes reflect changes in sedimentation between the two. Clays are predominantly mixtures of montmorillonite and quartz, but kaolinitic clays occur in some areas in different formations. Those at the base of the Tuscaloosa can be used in making face brick. Bauxite and kaolin from the Nanofalia Formation are used in refractory products. Fluvial clays from several river valleys, Miocene clay deposits, and extensive montmorillonite-type clays can be used for making brick.—*from* Author's abstract

02111 **Clausen, Eric N.** Pseudokarst features in Wyoming Badlands—The Madden Caves [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 15, 1969.

Cleveland, George B. *See* Blanc, Robert P. 07693

02371 **Clifton, H. Edward.** Tektite I—60 days under the sea: Geotimes, v. 14, no. 4, p. 10-12, illus., 1969.

Reviewed are the limitations of marine geological research with deep submersibles and scuba diving, the physiological problems with oxygen and inert gases, and experiments in their resolution by saturation diving and seafloor habitat. Project Tektite, sponsored by the U.S. Dept. Interior, U.S. Navy, NASA, and the General Electric Co., is an experiment in living and working on the seafloor off St. John, Virgin Islands. The four-compartmented habitat, for three biologists and one geologist, is described. In the U.S. Geol. Survey's exploration of the continental shelf, potentially

valuable mineral deposits have been located by shipboard sampling and marine geophysical techniques, but few observed at first hand. Extension to greater depths of techniques being tested in Tektite I could produce such information. Cooperation with biologists is necessary.—GDC

Cluff, Lloyd. *See* Slemmons, David B. 02237

Clyde, Calvin G. *See* Abaza, Mohamed M. I. 02491

02275 **Coats, R. R.** Upper Paleozoic formations of the Mountain City area, Elko County, Nevada, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1967: U.S. Geol. Survey Bull. 1274-A, p. A22-A27, illus., 1969.

Cocke, J. M. *See* Heckel, Philip H. 02283

07683 **Cocke, J. M.; Cocke, N. C.** Classification and distribution of Missourian (Upper Pennsylvanian) geyerophyllid corals from Kansas: Kansas Acad. Sci. Trans., v. 71, no. 1, p. 38-48, illus., table, 1968.

Geyerophyllid corals are distinctive faunal elements of Missourian (Upper Pennsylvanian) rocks of eastern Kansas. These corals typically have columella attached to cardinal septa and are either solitary and flaring or conico-cylindrical solitary and fasciculate forms. The corals from Kansas are included here in the family Geyerophyllidae which in the present paper is amended to include all corals which have (1) columella connected to the cardinal septum, (2) lonsdaleoid dissepiments, and (3) periaxially sagging tabulae. Also included in the family are corals which are morphologically similar to those above but in which origin of the columella is uncertain.—Authors' abstract

Cocke, N. C. *See* Cocke, J. M. 07683

02276 **Cohee, G. V.; Bates, R. G.; Wright, W. B.** Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1967: U.S. Geol. Survey Bull. 1274-A, p. A1-A59, illus., 1969.

Stratigraphic names adopted, revised, reinstated, or abandoned are listed alphabetically in a table. The age of the unit, the revision, the area involved, the author's name, and the date of publication of the report are given for each name. Following the table, short papers (cited separately) deal with: newly named Paleozoic formations in the Mountain City area, Elko County, Nev.; Cenozoic and Mesozoic formations on Kodiak and adjacent islands of Alaska; Jurassic formations in the McCarthy C-5 quadrangle, Alaska; and the Precambrian Wehutty Formation of North Carolina.—GVC

02397 **Collings, M. R.; Wiesnet, D. R.; Fleck, W. B.** Water resources of the Millers River basin, north-central Massachusetts and southwestern New Hampshire: U.S. Geol. Survey Hydrol. Inv. Atlas HA-293, 4 sheets, scale 1:125,000, text, 1969.

Sheet 1 contains information on annual water budget and water use; sheet 2, surface water; sheet 3, ground water, and sheet 4, quality. The bedrock map reveals the northerly alinement of the geology; axes of folds, outcrop patterns, and major faults are all roughly parallel. The surficial geologic map indicates glacial, colian, river-terrace and swamp deposits and alluvium. The water-favorability map shows that areas best suited for ground-water development are in the stratified glacial drift in stream valleys. No attempt is made to assess potential yields of bedrock. In general ground water is of satisfactory quality.—MCM

Collins, Gary. *See* Dodd, John D. 07590

02289 **Colquhoun, D. J.** A fossil assemblage from the Wicomico Formation in Berkeley County, South Carolina—Reply [to discussion by C. W. Cooke of 1968 paper]: Geol. Soc. America Bull., v. 80, no. 6, p. 1139-1140, 1969.

Cooke's hypothesis (ibid., p. 1137-1138) of nondeposition of marine Pleistocene sediments landward of the Surry scarp is rejected for reasons given here. Colquhoun points out reasons for the use of the term 'scarp' in connection with these coastal terraces and suggests that the use of relative straightness of shorelines, as used by Cooke, is a poor criterion for identifying shorelines of emergence and submergence. —VSN

02356 **Colquhoun, D. J.; Heron, S. Duncan, Jr.; Johnson, Henry S., Jr.; Pooser, W. K.; Siple, George E.** Up-dip Paleocene-Eocene stratigraphy of South Carolina reviewed: South Carolina Div. Geology Geol. Notes, v. 13, no. 1, p. 1-25, 26-a—26-l, illus., 1969.

This paper provides concise background data for interpretation of the up-dip early Tertiary coastal-plain strata from central South Carolina to the border of Burke and Screven Counties, Ga. Detailed information concerns the type of stratigraphy, variations in lithology, mineralogy, common sedimentary structures, paleontology, depositional environments, contacts, age, and correlation. Typical stratigraphic sections were chosen either for well-exposed strata, or for importance of their contained strata in correlation. Two major rises in sea level are apparent: the first between Late Cretaceous and early Eocene time was followed by regression and fluvial erosion; the second from middle Eocene to late Eocene or Oligocene was essentially transgressive, with minor fluctuations. The Black Mingo, Congaree, McBean, and Barnwell Formations are discussed.—GDC

07668 **Colton, George W.** Bedrock geology of the Waterville quadrangle, Lycoming County, Pennsylvania: Pennsylvania Geol. Survey Prog. Rept. 174, scale 1:24,000, text, 1968.

Flagstone, the only commercial product from bedrock of the Waterville quadrangle, is obtained from the red bed and lower sandstone sequences. Most of the largest quarries are located stratigraphically a short distance above or below a red bed unit provisionally designated the Devonian Mount Pleasant(?) Red Shale.—MCM

02112 **Compton, Robert R.** Thrusting in northwest Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 15, 1969.

Condon, W. H. *See* Clark, Sandra H. B. 02252

Connor, J. J. *See* Miesch, A. T. 07585

02113 **Cook, Kenneth L.; Iverson, R. M.; Strohmeier, M. T.** Bottom gravity meter survey of the Great Salt Lake, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 16, 1969.

02114 **Cook, Kenneth L.** Late Cenozoic structures of the southwestern United States and the new global tectonics [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 16-17, 1969.

02115 **Cook, Kenneth L.; Khattab, Mohamed M. M.** Thrusting in northwestern Utah indicated by gravity and magnetic surveys [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 17, 1969.

02267 **Cooke, C. Wythe.** A fossil assemblage from the Wicomico Formation in Berkeley County, South Carolina—Discussion [of paper by D. J. Colquhoun, S. W. Herrick, and H. G. Richards, 1968]: Geol. Soc. America Bull., v. 80, no. 6, p. 1137-1138, 1969.

Cooke discusses the validity of criterion for classifying the coastal terraces of South Carolina as Pleistocene, and points out that Colquhoun and others' (ibid., v. 79, no. 9, p. 1211-1220, 1968) 'Surry scarp' rises above the shoreline of the Wicomico sea, a shoreline of submergence and the 'Dorchester scarp' forming the mainland shore of the Penholoway sea, following the Wicomico, was a shoreline of emergence. Colquhoun's area 7 is one of barrier islands built during Penholoway time of sand

from the mainland. Cooke objects to the use of 'scarp' in reference to gently sloping sides of a former estuary.—VSN

Cooley, M. E. *See* Repenning, C. A. 02251

02390 **Cooper, J. F., Jr.; Dunning, G. E.** Struvite found at Mono Lake: California Div. Mines and Geology Mineral Inf. Service, v. 22, no. 3, p. 44-45, illus., 1969.

Since the description of newberyite and monetite from Paoha Island (Ribbe and Cohen, 1966), more than 200 specimens of monetite-coated newberyite from that diatomite locality have been examined in the laboratory. Five had a residual core of grayish transparent material resembling gypsum. Its properties, chemical analysis and X-ray data confirmed it to be struvite, another mineral not previously known to occur in California. Heavily pitted, the partially replaced struvite crystals show a nearly parallel retreat of faces, the largest one with remnants of original crust 6 mm thick. Probably the struvite was only recently exposed by the wind which removed the surrounding diatomite. No monetite shell was found on any of the struvite; otherwise bladed newberyite would form.—GDC

Cooper, John R. *See* Wilson, Eldred D. 02563

02306 **Cowan, W. R.** Pleistocene geology of the Brantford area (east half), southern Ontario: Ontario Dept. Mines Prelim. Geol. Map P. 516, scale 1:50,000, text, 1969.

02459 **Cracraft, Joel.** Notes on fossil hawks (Accipitridae): Auk, v. 86, no. 2, p. 353-354, 1969.

Two fossil accipitrids from the early Eocene and late Oligocene of North America are recorded. The first represents the second oldest fossil of the Falconiformes and the oldest record for the Accipitridae. The latter is apparently a previously unknown species of the genus *Buteo*.—KAF

02332 **Crain, Leslie J.** Ground-water pollution from natural gas and oil production in New York: New York Water Resources Comm. Rept. Inv. RI-5, 15 p., illus., 1969.

Natural gas is produced throughout the central and western part of New York State, whereas oil production has been limited mainly to Allegany and Cattaraugus Counties. Oil production, and particularly secondary recovery by the water-flooding method, has resulted in pollution of ground- and surface-water supplies with oil and salt water. Pollution from active oil fields has been caused by separator units that dispose wastes on the ground, by leakage and spillage from wells, and in abandoned fields by upward movement of oil and salt water under artesian pressure through uncapped or leaking wells. Oil pollution has been reported only from areas where active or abandoned fields are populated; pollution problems are expected to increase as areas become populated or are developed for sources of water supply. Additional study is needed for delineation, occurrence, and elimination of pollution.—*from* Author's abstract

02334 **Cramer, Fritz H.** Considérations paleogeographiques à propos d'une association de microplanctontes de la série gothlandienne de Birmingham (Alabama, U.S.A.): Soc. Geol. France Bull., ser. 7, v. 10, no. 1, p. 126-131, illus., 1968[1969].

A well-preserved assemblage of acritarchs (about 29 species, 3 new, listed here but described in another paper, Cramer 1968), plant spores, and chitinozoans, from the Lower Silurian Red Mountain Formation south of Birmingham, characterized by *Veryhachium? carminae*, contains many acritarchs in common with the Neagha and Maplewood Formations, New York; these are remarkably different from Silurian assemblages in Ohio, Indiana, Illinois, and the Rochester Formation in New York and Ontario, all characterized by *Deunffia furcata*. Cramer plots the regional distribution of these assemblages and correlatives in Europe and Africa, and shows them to be roughly parallel to Silurian magnetic paleolatitudes (with the continents in different relative position), and to constitute "palynological" provinces related to paleoclimatic zonation.—VMJ

02408 **Crawford, Thomas J.** Pre-Tuscaloosa and pre-Barnwell erosion in east-central Georgia [abs.]: Georgia Acad. Sci. Bull., v. 27, no. 2, p. 89, 1969.

02116 **Crelling, John Crawford.** Chemistry of a lamprophyre dike in the Spanish Peaks complex, Colorado [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 17-18, table, 1969.

Cremer, Marcelyn. *See* Keith, Terry E. C. 07537

02117 **Crittenden, Max D., Jr.** Interaction between Sevier orogenic belt and Uinta structures near Salt Lake City, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 18, table, 1969.

Crittenden, Max D., Jr. *See* Mullens, Thomas E. 02140

Crofts, F. C. *See* Blair, Graeme J. 02175

Crooks, T. J. *See* Gries, J. P. 02090

02130 **Crosby, Gary W.** Vertical movements and overthrusting at the eastern edge of the Great Basin [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 19, 1969.

02290 **Crosby, Gary W.** Radial movements in the western Wyoming salient of the Cordilleran overthrust belt: Geol. Soc. America Bull., v. 80, no. 6, p. 1061-1077, illus., table, 1969.

Sinuous overthrust belts at geosyncline-craton boundaries form a series of salients (convex cratonward) and re-entrants. Structural patterns suggest movements diverging across salients and converging across reentrants with mass movement toward the craton. A map plot of 22 mean movement directions indicates about 70° of divergence along the western Wyoming salient from Idaho through Wyoming, and into Utah. The statistical center of divergence is in northern Oneida County, Idaho, where maximum uplift was greater than 45,000 ft. Inasmuch as overthrust plates on the salient apparently do not involve crystalline basement rock, origin of the salient is best explained as a radial gravitational-gliding response of the sedimentary sequence to maximum local uplift at the center of diverging movement.—HCW

02349 **Curtis, Bruce F.** A university course emphasizing geology from well logs: Log Analyst, v. 10, no. 1, p. 24-26, illus., 1969.

At the University of Colorado a course in Subsurface Geology acquaints advanced students with the many geological uses of borehole records to train geologists who can use most logs, recognize the need for professional analysts, or become expert in some aspects of log analysis. An understanding is required particularly of stratigraphic and structural geology; there is no textbook, but substantial selected reading, and laboratory sessions in addition to basic lectures.—GDC

07534 **Dachille, Frank; Simons, P. Y.; Roy, Rustum.** Pressure-temperature studies of anatase, brookite, rutile and TiO_2-II: Am. Mineralogist, v. 53, nos. 11-12, p. 1929-1939, illus., table, 1968.

Anatase and brookite have been converted in opposed-anvil high pressure apparatus to a new phase, TiO_2-II, which has the αPbO_2 structure. Starting with anatase and II, or brookite and II, *p*-T reaction boundaries were obtained which yield apparent triple points among the polymorphs anatase-II-rutile and brookite-II-rutile in the region of 480°C and 9 kbars. Inasmuch as no reversal transitions were observed along these boundaries, the boundaries approximate equilibria on the high temperature side, in a stable or metastable relation. Further, because brookite may be a crystalline solution, it would fall out of the system TiO_2. Fluid compositions may be of critical importance in the various transitions to rutile.—*from* Authors' abstract

Dane, Carle H. *See* Landis, Edwin R. 02338

02415 **Danes, Z. F.** Gravity results in the State of Washington [abs.]: Northwest Sci., v. 43, no. 1, p. 34, 1969.

07645 **Daniel, Thomas W., Jr.; Hastings, Earl L.** The geology and mineral resources of Limestone County, Alabama—A reconnaissance survey: Alabama Geol. Survey Circ. 46, 33 p., illus., tables, geol. map, 1968.

Rocks exposed in the county range from Middle Ordovician to Upper Mississippian, and are chiefly limestone, dolomite, shale, and chert. Measured sections accompany discussion of the stratigraphy and petrology. Some of the 19 caves mapped in the county are described. Mineral resources include clay and shale, iron, limestone, phosphate, sand and gravel, and oil and gas. A geologic map of the county, and a geologic and structure map of Pisgah Dome accompany the report.—ESL

07570 **Datta, R. K.; Roy, Rustum.** Order-disorder in $MgAl_2O_4$. The systems—$MgAl_2O_4$-$LiAl_5O_8$, $MgAl_2O_4$-$NiCr_2O_4$, $MgAl_2O_4$-$NiAl_2O_4$, and $NiAl_2O_4$-$ZnAl_2O_4$: Am. Mineralogist, v. 53, nos. 9-10, p. 1456-1475, illus., tables, 1968.

Serious question has been raised about merely classifying $MgAl_2O_4$ as a normal spinel. Infrared spectra, the appearance of extra X-ray diffraction peaks, change of the lattice parameter (8.076 ± 0.002 A at 1200°C and 8.084 ± 0.001 A at about 2100°C), the nature of crystalline solutions with $LiAl_5O_8$ and $NiAl_2O_4$, etc., all point to the fact that although at high temperature $MgAl_2O_4$ may tend to be a normal spinel, there is appreciable change in the distribution of cations in the tetrahedral and octahedral sites with temperature. The possibility of a first-order transition near 1240°C is mooted.—Authors' abstract

02099 **Daugherty, Franklin W.; Vitaliano, Charles J.** Sand Creek sill complex, Madison and Gallatin Counties, Montana [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 19-20, 1969.

07640 **Davidson, A.; Wyllie, P. J.** Opaque oxide minerals of some diabase-granophyre associations in Pennsylvania: Econ. Geology, v. 63, no. 8, p. 950-960, 1968.

Differentiation of diabase toward the iron-enrichment stage is accompanied by a change from magnetite with exsolved ulvospinel, intimately associated with ilmenite, to Ti-poor magnetite that occurs as rims or separate late crystals. Skeletal ilmenite in the granophyre diabases suggests that "in the igneous differentiation sequence an aqueous fluid developed within the crystallizing intermediate magma and was capable of dissolving iron from the titaniferous magnetite intergrowths." Such fluid would be a potential source of Cornwall-type magnetite deposits.—WSW

02313 **Davies, J. C.** North Shoal Lake area (west and east sheets), District of Kenora: Ontario Dept. Mines Prelim. Geol. Maps P. 527-528, scale 1 in. to 1/4 mi., text, 1969.

02291 **Davis, Gregory A.** Tectonic correlations, Klamath Mountains and western Sierra Nevada, California: Geol. Soc. America Bull., v. 80, no. 6, p. 1095-1108, illus., 1969.

Geologic relationships indicate that the Melones fault of the Foothills fault system extends into the Klamath region as the Trinity thrust fault. Correlation of the two faults appears probable on the basis of stratigraphic and structural similarities in their hanging wall blocks, presence of serpentinite beneath each fault, possible Late Jurassic age of the two faults, and a curvilinear trace for the Trinity-Melones fault which parallels nearby structural trends. Eastward steepening of the proposed Klamath-Sierran thrust faults is related to their increasing proximity to the Sierran synclinorium and to their rooting into its western flank. The geometry of Mesozoic orogenesis in the Klamath-Sierran region can be best explained by the convergence of subcrustal convection cells along the axial zone of the Sierran synclinorium.—*from* Author's abstract

Davis, J. C. *See* Esler, J. E. 07586

02416 **Dayharsh, Fred L.; Norberg, John R.** A reconnaissance of ring dikes and related features in the Upper Crab Creek drainage area [abs.]: Northwest Sci., v. 43, no. 1, p. 34, 1969.

02445 **Deines, P.; Gold, D. P.** The change in carbon and oxygen isotopic composition during contact metamorphism of Trenton limestone by the Mount Royal pluton: Geochim. et Cosmochim. Acta, v. 33, no. 3, p. 421-424, illus., 1969.

The C and O isotopic composition of the Trenton limestone was systematically altered by metamorphism associated with the emplacement of the Mount Royal pluton [Quebec, Canada]. Values approach those thought to be characteristic of carbonatites, and suggest that the isotopic composition of carbonatites is of limited diagnostic value.—Authors' abstract

deLaguna, Wallace. *See* Warren, M. A. 07644

Denahan, Stephen A. *See* Blanchard, Frank N. 07527

Dennis, C. L. *See* Hilchie, D. W. 02358

02456 **Denson, N. M.; Harshman, E. N.** Map showing areal distribution of Tertiary rocks, Bates Hole-Shirley Basin area, south-central Wyoming: U.S. Geol. Survey Misc. Geol. Inv. Map I-570, scale 1:125,000, 1969.

Depman, Albert J. *See* McGavock, Cecil B., Jr. 07509

02564 **DePuy, G. W.** (compiler). Tunnel geology bibliography-U.S. Bur. Reclamation Bibliography 245: Denver, Colo., U.S. Bur. Reclamation, Office Chief Engineer, 50 p., 1969.

02575 **deWaard, D.** Facies series and P-T conditions of metamorphism in the Adirondack Mountains: Koninkl. Nederlandse Akad. Wetensch. Proc., ser. B, v. 72, no. 2, p. 124-131, illus., 1969.

The metamorphic facies series of the Adirondacks is presented as a P_{total}-T gradient on a petrogenetic grid. The grid consists of the curve for the reaction: orthopyroxene + anorthite ⇌ clinopyroxene + almandine + quartz, the curve for the solvus crest of alkali feldspars and the stability boundaries of the Al silicates, and those of cordierite and almandine. The gradient begins between 625° and 650°C and at a depth of about 20 km, it enters the granulite facies between 675° and 700°C and a depth of about 22 km, and it reaches a maximum of perhaps 800°C and a depth of about 30 km. The gradient is curved as it enters and leaves the stability field of coexisting cordierite and almandine; from medium to high metamorphism (from W to E in the Adirondacks), the T/P ratio gradually decreases.—*from* Author's abstract

07584 **Dickinson, S. K.** Diamond synthesis from cobalt-carbon and manganese-carbon systems [abs.], *in* Crystal growth 1968—Internat. Conf. Crystal Growth, 2d, Birmingham, U.K., 1968, Proc.: Jour. Crystal Growth, v. 3-4, p. 430, 1968.

Dietrich, J. A. *See* Hoover, D. B. 02464

02279 **Dinkins, Theo H., Jr.** Subsurface stratigraphy of Copiah County, *in* Copiah County geology and mineral resources: Mississippi Geol., Econ. and Topog. Survey Bull. 110, p. 111-140, table, 1969.

The stratigraphic column applicable to the subsurface of Copiah County includes strata from the Hosston Formation of Lower Cretaceous age to the Bucatunna Formation of Oligocene age. The formations and their contacts are discussed in general terms. Formations discussed in this report, with the exception of the Clayton Formation, are based on rock unit subdivisions and should be regarded as such. The search for oil and gas, based primarily on structural prospects, has been disappointing. Future exploration with more emphasis on possible stratigraphic accumulations may prove favorable. The five known piercement-type salt domes are apparently the

result of secondary stages of growth. These domes exhibit growth more or less contemporaneous with deposition, for various lengths of time.—Author's abstract

02529 **Dobell, J. P.; Pollock, D. W.** Geology in 1968: Mining Eng., v. 21, no. 2, p. 73-74, 1969.

Mineral exploration activity increased in many parts of the world during 1968. The search for nickel, uranium, copper, and phosphate was particularly active. Research projects undertaken by U.S. and Canadian industrial concerns, governmental agencies, and educational institutions include work in oceanography, chemical analysis, ore deposit and ore fluid genesis, trace-element distribution, statistical analysis, remote sensing, and electron-probe applications.—MAC

07590 **Dodd, John D.; Webster, Ruth M.; Collins, Gary; Wehr, Larry.** A consideration of pollen, diatoms and other remains in postglacial sediments: Iowa Acad. Sci. Proc. 1968, v. 75, p. 197-209, illus., tables, 1968.

The significance of pollen and diatoms in post-glacial sediments from a shallow bay of Lake Okoboji, Iowa, is considered. The presence of other microfossils is noted with emphasis on those of Cretaceous origin: foraminifera, coccoliths, radiolarians, and hystrichosphaerids. Problems encountered and discussed include recognition of Chrysophyte statospores, redeposition, interpretation of data from lower levels, and reliability of radiocarbon dates applied to organic matter from aquatic vegetation.—Authors' abstract

02417 **Dodds, R. Kenneth.** The age of the "Columbia River Basalts" near Astoria, Oregon [abs.]: Northwest Sci., v. 43, no. 1, p. 34, 1969.

07636 **Doe, B. R.; Tilling, R. I.; Hedge, C. E.; Klepper, M. R.** Lead and strontium isotope studies of the Boulder batholith, southwestern Montana: Econ. Geology, v. 63, no. 8, p. 884-906, illus., tables, 1968.

Isotope ratios of Pb in feldspar range widely from pluton to pluton: 16.9-18.1 for 206/204, 15.4-15.7 for 207/204, and 37.7-38.5 for 208/204.Whole-rock initial Sr-87/Sr-86 is 0.706-0.709. Variation in Pb isotope ratios within Butte Quartz Monzonite, plus differences in ratios between megacryst and groundmass feldspars in Donald pluton suggest incomplete isotopic mixing; similarity of Butte ore Pb to feldspar Pb of Butte Quartz Monzonite, therefore, has genetic significance. Isotope data suggest that batholith rocks result from partial melting of lower crust or upper mantle; assimilation of upper crustal material is necessary if source material resembled oceanic tholeiites.—WSW

Doelling, Heilmut H. *See* Ritzma, Howard R. 02577

Doherty, P. R. *See* Wenckus, J. F. 07583

07545 **Dollase, W. A.** Refinement and comparison of the structures of zoisite and clinozoisite: Am. Mineralogist, v. 53, nos. 11-12, p. 1882-1898, illus., tables, 1968.

The crystal structures of zoisite and clinozoisite, $Ca_2Al_3Si_3O_{12}OH$, have been refined to conventional R-factors of 4 and 3 percent, respectively. Although the general topologies conform to those suggested in earlier studies, the lto-proposed relationship between the structures does not hold exactly, i.e., the zoisite positional parameters differ by as much as 0.33 A from those obtained by "twinning" clinozoisite on (100) by an n-glide operation. These differences result, for example, in different calcium atom surroundings and Si-O-Si angles in the two polymorphs.—*from* Author's abstract

02100 **Dolliver, Claire Vincent.** Post-faulting development of Kyle Cañon, Spring Mountains, Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 20, 1969.

02270 **Donan, John G., Jr.** Commercial coals and marketing data of the Western Kentucky Coal Field, *in* Middle and Upper Pennsylvanian strata in Hopkins and Webster Counties, Kentucky—Geol. Soc. Kentucky, Ann. Spring Field Conf. 1969: [Lexington, Ky.] Kentucky Geol. Survey, p. 66-70, 1969.

In this field of 6,400 sq mi in 14 counties of the State, total estimated original coal reserve has been calculated as 39 billion tons; recoverable reserves estimated 18.5 billion tons. Five of the counties produce 99 percent of the annual production of 46 million tons, including Hopkins County (12,127,000) and Webster County (1,517,000). Nine mines are listed in the 42 largest bituminous mines of the United States; two of these are in Hopkins County. A brief discussion of each of the five economically important seams in western Kentucky—Nos. 4, 6, 9, 11, and 14—includes typical analyses and average thicknesses.—GDC

Donnay, Gabrielle. *See* Gaines, Richard V. 07529

Donnay, J. D. H. *See* Allmann, R. 02178

02360 **Donnell, John R.** Paleocene and lower Eocene units in the southern part of the Piceance Creek basin, Colorado: U.S. Geol. Survey Bull. 1274-M, p. M1-M18, illus., table, 1969.

The Wasatch Formation, in an area of several hundred square miles in the vicinity of DeBeque, Grand Valley, Mesa, and Collbran, Colo., may be separated into three members. The upper and lower members, Shire and Atwell Gulch, are dominantly variegated claystone. The intervening Molina Member consists primarily of thick brown ledge-forming massive sandstone with thin interbeds of variegated claystone. Paleocene plant and vertebrate fossils are in the lower 200 feet of the Atwell Gulch Member, and the Shire Member contains middle early and late early Eocene vertebrate fossils. No fossils have been reported from the Molina or the upper part of the Atwell Gulch.—JRD

02440 **Downs, George R.; Henderson, Bonnie C.** Employment vs graduate study: Geotimes, v. 14, no. 4, p. 15-16, table, 1969.

As part of the American Geological Institute's Manpower Studies, bachelor-degree graduates in geoscience of 1968 were surveyed as to how many went immediately into jobs, into graduate study, into military service, or left geology for another field; also as to subject majors, types of employers, work activity, and starting salaries. The largest number, 38 percent, enrolled in graduate-degree programs, 30 percent accepted employment, 23 percent were in military service, 9 percent in other fields, and 2 percent looking for work. Of those now in school, 67.6 percent indicated they intend to pursue graduate studies later. Figures are given for the diversified information requested.—GDC

Doyle, Michael V. *See* Whitehead, Donald R. 02520

07654 **Drahovzal, James A.** Physiography of Alabama, *in* Geology of the Alabama Coastal Plain—A guidebook (C. W. Copeland, editor): Alabama Geol. Survey Circ. 47, p. 7-15, illus., 1968.

Alabama lies in parts of five physiographic provinces: Highland Rim Section, Cumberland Plateau Section, southernmost Valley and Ridge, Piedmont Upland, and East Gulf Coastal Plain. Six divisions of the Gulf Coastal Plain are described also.—ESL

02457 **Drake, Avery Ala, Jr.; Epstein, Jack B.; Aaron, John M.** Geologic map and sections of parts of the Portland and Belvidere quadrangles, New Jersey-Pennsylvania: U.S. Geol. Survey Misc. Geol. Inv. Map I-552, scale 1:24,000, 1969.

Dunning, G. E. *See* Cooper, J. F., Jr. 02390

07618 **Durrenberger, Robert W.** Elements of California geography: Palo Alto, Calif., National Press Books, 174 p., illus., tables, 1968.

Chapter 1, *Landform regions*, contains brief descriptions of the landform provinces: Klamath Mts., Cascades, Modoc Plateau, Basin and Range, Sierra Nevada, Coast Ranges, Central Valley, Mojave Desert, Salton Basin, Transverse Ranges and Peninsular Ranges.—MCM

Dwornik, Edward J. *See* Roedder, Edwin. 07567

07689 **Eakins, P. R.; Hashimoto, T.; Carlson, E. H.** Grand-Détour—Village Lakes area, Mistassini Territory and New Quebec [also French edition]: Quebec Dept. Nat. Resources Geol. Rept. 136, 142 p., illus., tables, geol. maps, 1968.

The map-area comprises three quadrangles: Natel Lake, Village Lakes, and Pivert Lake. All the rocks are Precambrian, and belong to the Superior Province. It is impossible to establish the real stratigraphic succession because metamorphism has destroyed the primary structures. A great thickness of basic lavas, tuffs and agglomerates, graywackes, shales, and siltstones was deposited and invaded by basic and ultrabasic sills. Later all were metamorphosed and a large quantity of granitic rocks emplaced. The youngest consolidated rocks are diabase and gabbro dikes. The metasedimentary rocks are divided into six units.—ESL

02101 **Eardley, A. J.** Charting the Laramide structures of western Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 20, 1969.

02102 **Eardley, A. J.** Chloride fall-out in the Great Salt Lake watershed [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 21, 1969.

02103 **Eaton, Gordon P.** Recent elevation changes in San Simon Valley, Arizona [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 21, 1969.

07676 **Eckhoff, N. D.; Hill, T. R.; Kimel, W. R.** Trace element determinations by neutron activation analysis—Theory and development: Kansas Acad. Sci. Trans., v. 71, no. 2, p. 101-135, illus., tables, 1968.

Neutron activation analysis (NAA) is rapidly becoming one of the most sensitive and accurate analytical techniques available to engineers and scientists, with sensitivities in the ppm to ppb range for 75 elements in a variety of background matrices. This paper considers theoretical developments concerning cosmic background, nuclear reactions, build-up and decay equations, decay processes, and gamma-ray interaction processes. Equipment such as the shield cavity, NaI(Tl) scintillation crystals, multichannel analyzers, and nuclear reactors and neutron generators as sources of neutrons, are discussed. Procedures to perform neutron activation analyses are developed. Data analysis computer codes developed at Kansas State University are discussed also. Analyses of data from several NAA experiments include bromine in sea water.—GDC

02418 **Eddy, Paul A.** Geohydrology of the Columbia Basin Project area, Washington [abs.]: Northwest Sci., v. 43, no. 1, p. 35, 1969.

02547 **Egleson, G. C.; Querio, C. W.** Variation in the composition of brine from the Sylvania Formation near Midland, Michigan: Environmental Sci. and Technology, v. 3, no. 4, p. 367-371, illus., tables, 1969.

Brines from 51 wells in a brine field near Midland, Mich., were analyzed for major and minor components. The Ca, Mg, Na, Sr, Cl, and Br ions, which make up the bulk of the total dissolved solids in the brine, are fairly constant, varying less than 10 percent above or below the mean. Another suite of ions—K, B, NH_3, Rb, Li, and I—varies from 25-50 percent above and below the mean. Analyses of trends and relationships among the ions indicate that dolomitization probably is the mechanism most important in determining the Ca, Mg, and Sr content of the brine; that the relative amounts of Li, I, and NH_3 are too high for them to have been derived directly from sea water evaporation; and that many interrelationships among the minor ions as yet are not well defined.—*from* Authors' abstract

02269 **Eicher, Don L.** Paleobathymetry of Cretaceous Greenhorn sea in eastern Colorado: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 5, p. 1075-1090, illus., 1969.

The Cretaceous Greenhorn sea reached maximum extent and presumably maximum depth at about the time of deposition of the upper Greenhorn and lower Carlile deposition. The depth is estimated in two ways—from the percentage of planktonic specimens in very diverse normal marine foraminiferal fauna and from inference of the paleoslope that the sea transgressed. The foraminiferal profile does not correspond to one expected from simple transgression and regression on a modern continental shelf but available evidence does indicate that water depth was at least 1,640 feet. If paleoslopes during Greenhorn time were comparable to paleoslopes during earlier period of deposition of the Lytle Formation, maximum depth of the Greenhorn seas at the time of maximum advance was on the order of 2,000 feet.—*from* Author's abstract

Einaudi, Marco. *See* Frondel, Clifford. 07548

02104 **Elliott, James E.; Wells, John D.** Variation of mineralization with geologic factors in the Cortez-Buckhorn area, Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 22, 1969.

02328 **Ellis, Brooks F.; Messina, Angelina R.; Charmatz, Richard; Ronai, Lili E.** Catalogue of index smaller foraminifera—V. 2, Tertiary planktonic foraminifera: New York, Am. Mus. Nat. History Spec. Pub., [583] p., illus., 1969.

This is the second volume of a three-volume catalog (V. 1, 1968, is cited in Abstracts of North American Geology for Jan. 1969) of index species selected on the basis of wide geographic distribution and restricted geologic range. Volume 2 contains 97 species and 7 subspecies of Tertiary planktonic foraminifers belonging to 17 genera of the families Heterohelicidae, Hantkeninidae, Globorotaliidae, and Globigerinidae of Globigerinacea. Specific determinations, illustrations, ages, and localities are presented as designated by each author; in an index to species names, the generic assignments used here, followed by other combinations, are listed for each species.—VMJ

02565 **Ellis, Michael J.; Adolphson, Donald G.** Basic hydrologic data, for a part of the Big Sioux drainage basin, eastern South Dakota: South Dakota Geol. Survey Water Resources Rept. 5, 124 p., illus., tables, 1969.

This report will make basic hydrologic data available for planning and studying water resources development in the Big Sioux drainage basin and will supplement a report to be published as U.S. Geol. Survey Hydrol. Inv. Atlas 311. Tabulated data include logs of test holes and observation wells, measurements of water levels in observation wells, selected physical properties of unconsolidated materials, surface-water records, and chemical analyses of water. A bibliography and glossary are appended.—MCM

07631 **Elsik, William C.** Palynology of a Paleocene Rockdale lignite, Milam County, Texas—[Pt.] 2, Morphology and taxonomy (end): Pollen et Spores, v. 10, no. 3, p. 599-664, illus., 1968.

Pollen taxa from the Paleocene Rockdale lignite from Milam County, Texas, are described and illustrated. Presence of several tropical forms adds to the list of diverse plant taxa recorded for the Wilcox flora. The lack of true *Quercus* pollen is noteworthy because it should be present in any temperate pollen assemblage of this age.—KAF

02433 **Emery, K. O.** Continental rises and oil potential: Oil and Gas Jour., v. 67, no. 19, p. 231-243, illus., 1969.

The global distribution, composition, and origin of continental rises and slopes are summarized. The author suggests that the possible occurrence of interbedded organic-rich silt and clay and sandy turbidites near the heads of continental rises may constitute an environment in which large concentrations of oil and gas have developed. Prospects probably are less favorable on the continental slopes because they include few sandstone layers suitable for accumulation of oil and gas. Exploratory drilling is needed before exploitation can be considered.—HHA

02567 **Emmons, R. C.** Strike-slip rupture patterns in sand models: Tectonophysics, v. 7, no. 1, p. 71-87, illus., 1969.

Sand, in models of strike-slip deformation, yields ruptures that suggest a genetic relationship between the fundamental drive in the form of horizontal translation and such possibly related phenomena as: concomitant dip-slip displacements at the surface; proliferation of ruptures at and near the surface to generate a rift pattern; segmentation into blocks by these ruptures, freeing them for discrete displacement relative to each other; thereby the creation of welts (horsts) and grabens in the rift pattern; adjoining arcuate thrusts, more strongly developed in a curved fundamental displacement; plateau type of uplift, and rises above and consequent to these thrusts.—Author's abstract

02535 **Englund, Kenneth J.** Geologic map of the Roaring Creek area, Randolph County, West Virginia: U.S. Geol. Survey Misc. Geol. Inv. Map I-577, scale 1:12,000, section, 1969.

Epstein, Jack B. *See* Drake, Avery Ala, Jr. 02457

02105 **Erickson, A. J., Jr.** Ore deposits of the Park City mining district [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 22-23, 1969.

02525 **Erskine, Christopher F.** Groundwater hydrology activities: Mining Eng., v. 21, no. 2, p. 78-80, 1969.

Ground-water problems are commonly encountered in the mining industry. A scientific approach, not extensively used in the past, will help to solve such problems in the future. Examples of the use of the scientific approach include: (1) hydrologic studies to evaluate the nature and extent of available water supplies for mining properties, (2) development of ground-water control technology for mining in areas of excessive water, and (3) studies on ways to control ground-water pollution caused by mining operations. A number of mining-related hydrologic research projects currently being conducted by the USBM, the USGS, and various universities are also described.—MAC

07586 **Esler, J. E.; Smith, P. F.; Davis, J. C.** KWIKR8, a FORTRAN IV program for multiple regression and geologic trend analysis: Kansas Geol. Survey Computer Contr. 28, 31 p., illus., tables, 1968.

This program incorporates features of several previously published programs. The matrix of regression coefficients contains 35 variables that may be combined in a number of different polynomial expansions. A number of options have been written into the program. Programs for one, two, or three independent variables are discussed.—ESL

Eugster, H. P. *See* McAtee, J. L., Jr. 07528

02444 **Evans, Bernard.** The nickel partition geothermometer applied to the prehistoric Makaopuhi Lava Lake, Hawaii: Geochim. et Cosmochim. Acta, v. 33, no. 3, p. 409-411, table, 1969.

Consequences of application of the nickel partitioning thermometer to minerals of the prehistoric Makaopuhi Lava are: (1) Poikilitic orthopyroxene did not crystallize in exchange equilibrium with groundmass augite, (2) readjustment of olivine compositions did not extend into the subsolidus range, and (3) poikilitic orthopyroxene probably crystallized in exchange equilibrium with phenocryst olivine at about 1040°C.—Author's abstract

Fagan, James M. *See* Carpenter, Robert H. 02519

Fahey, Joseph J. *See* Allen, Victor T. 02196

02517 **Fallaw, Wallace; Wheeler, Walter H.** Marine fossiliferous Pleistocene deposits in southeastern North Carolina: Southeastern Geology, v. 10, no. 1, p. 35-54, illus., tables, 1969.

The term Neuse Formation is proposed for these marine Pleistocene deposits, which have previously been included in the Pamlico and Flanner Beach Formations, neither of which is a distinct lithologic unit. The type locality of the Neuse is in Pamlico County on the north bank of the Neuse River estuary (a measured section is included); it occurs east and west of the Pamlico terrace scarp and does not seem to be related to it. The formation consists of four facies, each with distinct sediments and a fauna dominated by pelecypods and gastropods.—ESL

Fang, J. H. *See* Robinson, P. D. 02203

Farrell, E. *See* Lipson, Herbert G. 07580

Farvolden, R. N. *See* Hughes, G. M. 02365

02340 **Feder, G. L.; Skelton, John; Jeffery, H. G.; Harvey, E. J.** Water resources of the Joplin area, Missouri: Missouri Geol. Survey and Water Resources, Water Resources Rept. 24, 97 p., illus., tables, 1969.

Water supplies in the Joplin area are available from streams, the shallow Mississippian limestone aquifer, and the deep Ordovician and Cambrian dolomite and sandstone aquifer. Most wells in the deep aquifer yield 100-300 gpm water of good quality. Water supplies from the shallow aquifer can be obtained from wells, mine workings, and springs; yields range from less than 10 to more than 300 gpm water generally of calcium bicarbonate type. Large abandoned zinc mines contain billions of gallons of water in storage and can yield 50-1,000 gpm continuously of rather poor quality water suitable only for industry. Springs will yield 100-500 gpm of generally good quality water of calcium bicarbonate type.—*from* Authors' abstract

02320 **Fenwick, K. G.** Finlayson Lake area (west and east halves), District of Rainy River: Ontario Dept. Mines Prelim. Geol. Maps P. 542-543, scale 1 in. to 1/4 mi., text, 1969.

07577 **Ferris, C. S., Jr.** Tertiary faults with reversed movements near Copper Mountain, central Wyoming: Wyoming Univ. Contr. Geology, v. 7, no. 2, p. 117-128, illus., table, 1968.

The eastern Owl Creek Mts. are part of a block of Precambrian and younger rocks moved upward and southward in early Eocene by a moderately high angle thrust fault. The toe of the thrust became broken by normal faulting and the part behind it became the Copper Mtn. arch. Cedar Ridge fault scarp in the southern part of the toe is composed of post-thrust arkoses of the lower Eocene Wind River Formation. Drill-hole data suggest that Wind River arkose exists in the subsurface north of Cedar Ridge fault, but in most of the toe, the Tepee Trail is underlain by Paleozoic and Precambrian rocks, indicating extensive erosion of the Wind River on the toe prior to Tepee Trail time. It is postulated that the Wind River horst blocks and perhaps the Steffen Hill complex were grabens at this time, and were faulted upward after Tepee Trail time.—*from* Author's abstract

02342 **Findlay, D. C.** The mineral industry of Yukon Territory and southwestern District of Mackenzie, 1967: Canada Geol. Survey Paper 68-68, 131 p., tables, 1969.

The value of Yukon mineral production increased from about 11 million dollars in 1966 to more than 15 million dollars in 1967, due mainly to introduction of two new producing mines, one near Whitehorse and one west of Dawson. Work done by the Geological Survey of Canada in the report area, and lode mining and exploration, placer mining, and coal mining and exploration in the principal mining districts are summarized.—MCM

02469 **Finney, J. J.; Kumbasar, Isik; Clark, Joan R.** Crystal structure of howlite, $Ca_2SiB_5BO_9(OH)_5$: Naturwissenschaften, v. 56, no. 1, p. 33-34, table, 1969.

Earlier infrared absorption studies suggested that both BO_3 and BO_4 groups were present in howlite although the occurrence of both kinds of borate groups in the presence of silicon had not been observed previously. Results of this analysis confirm

the original suggestion. The structure is a three-dimensional framework with rings and spirals of borate and silicate tetrahedra linking through silicate oxygen atoms to borate chains along the *c* direction, and contains single and double chains of Ca polyhedra.—ESL

Finney, J. J. *See* Grybeck, Donald. 07539

Fisher, D. E. *See* Loveland, W. 02442

07562 **Fisher, D. Jerome.** Albite, variety cleavelandite, and the signs of its optic directions: Am. Mineralogist, v. 53, nos. 9-10, p. 1568-1578, illus., tables, 1968.

Type cleavelandite from Chesterfield, Mass., is a relatively pure variety of albite characterized by its occurrence in granitic pegmatites (especially in hydrothermal units) in masses of warped or curved, generally (010) lamellae, some of which form albite twins. Crystal faces and cleavages, except (010) are not commonly evident. Platy albite lacking these qualities should not be designated as cleavelandite. By assigning signs to the optic directions and using the values of the Kohler angles among these, one can differentiate readily between twinning types in the albites.—Author's abstract

02541 **Fisher, David E.** Silicon in iron meteorites and the Earth's core: Nature, v. 222, no. 5196, p. 866-867, 1969.

A search was made for silicon in the metal phase of several iron meteorites in an attempt to test those Earth models which assume that silicon occurs as a major component in the core of the Earth. The limit set in this work, less than 50 ppm Si in the metal phase of iron meteorites, is considered more likely to be relevant to the Earth core problem than the abundances found by Ringwood and later workers. Such a limit argues against high (about 20 percent) Si abundances in the core required by the models of Ringwood (1958, 1959) and MacDonald and Knopoff (1958).—DBV

02573 **Fisher, David E.** Uranium content of some stone meteorites and their Pu-Xe decay interval: Nature, v. 222, no. 5199, p. 1156, table, 1969.

A critical test of Kuroda's model for galactic nucleosynthesis would be to measure the U in Moore County eucrite by a different technique; in particular, the difference between the measured and predicted U abundances is significant. The Pena Springs aubrite would show concordancy with a U abundance of about 20 ppb; measured values are close to this, but there is some doubt as to the validity of the measurements. This letter reports measurements of the uranium abundances in Moore County, Pena Blanca Springs, and several "normal" eucrites, by the fission track method. The Moore County datum of 25 ppb U is in good agreement with previous data and far from the value of 130 ppb predicted by Kuroda's calculations; the Moore County decay intervals therefore remain discordant. The Pena Blanca Springs datum of 8 ppb U is in reasonable agreement with previous data and far from the 20 ppb necessary for condordancy.—DBV

02106 **Fisher, Frederick S.** Tertiary mineralization in the Stinkingwater mining region, Park County, Wyoming—A preliminary report [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 23, 1969.

Fisher, George E. *See* Howe, George M. 07633

07619 **Fisher, John J.** Preliminary quantitative analysis of surface morphology of inner continental shelf, Cape Henry, Virginia, to Cape Fear, North Carolina, *in* National symposium on ocean sciences and engineering of the Atlantic Shelf, Philadelphia, 1968, Trans.: Washington, D.C., Marine Technology Soc., p. 143-148, illus., 1968.

Bottom contour maps were constructed from published U.S. Coast and Geodetic soundings of part of the Atlantic continental shelf along the Virginia-North Carolina coast. Soundings were contoured at a six foot interval and resulting topography quantitatively analyzed. The following index parameters were determined: local re-

lief, morphology, slope, elongation, profile, and crestal-trough. Terrain cell distributions were established on the basis of these parameters. Analysis of terrain cells suggests existence of drowned former mainland areas on the inner shelf in the Cape Henry to Cape Hatteras region. Further south on the shelf, in the Cape Hatteras to Cape Fear area, there is little evidence of constructional forms although scattered east-west cells may represent drowned barrier islands.—*from* Author's abstract

Fisher, Richard. *See* Waters, Aaron C. 02431

Fleck, W. B. *See* Collings, M. R. 02397

07544 **Fleet, M. E.** On the lattice parameters and superstructures of pyrrhotites: Am. Mineralogist, v. 53, nos. 11-12, p. 1846-1855, illus., tables, 1968.

Pyrrhotites in the compositional range 50.0 to 47.7 atomic percent Fe have been synthesized at 700°C and low pressure and examined by X-ray diffraction procedures. Powder photographs of the quenched preparations indicate the existence of a superstructure with the hexagonal $A\sqrt{3}$, 2C cell (where A and C are respectively the a and c parameters of the simple NiAs cell) in pyrrhotites having more iron than 48.8 atomic percent Fe. Pyrrhotites more sulfur-rich than this have a superstructure with a hexagonal 2A, 4C cell. Plots of the lattice parameters of the pyrrhotites studied against composition reveal a marked discontinuity at 48.8 atomic percent Fe. The superstructure phase boundary and the discontinuity are correlated to a structural rearrangement at this composition.—Author's abstract

02345 **Fleischer, R. L.; Price, P. B.; Walker, R. M.** Nuclear tracks in solids: Sci. American, v. 220, no. 6, p. 30-39, illus., 1969.

Charged particles leave damage trails, fission-tracks, in nonconducting solids such as minerals, glass, and plastics. In this semipopular article the state-of-the-art is reviewed ten years after the first description of fission-tracks in 1959. Geologic ages determined by analyzing etched fission-tracks are compatible with those determined by other techniques and the method may be used for rocks of any age. Other applications include studies of meteorites and cosmic rays.—DWR

02448 **Fleischer, R. L.; Viertl, J. R. M.; Price, P. B.** Age of the Manicouagan and Clearwater Lakes craters: Geochim. et Cosmochim. Acta, v. 33, no. 4, p. 523-527, illus., tables, 1969.

Track dating of Manicouagan Crater glass gives 208 ± 25 m.y. Partial track fading in a Clearwater Lakes sample yields results consistent with the K-Ar age: 290 ± 30 m.y. The Clearwater Lakes Craters are, therefore, not contemporaneous with any known tektite fall. Track annealing studies are important to the determination of reliable fission track ages.—Authors' abstract

Flinn, E. A. *See* Wuenschel, P. O. 02499

Flores, Jose. *See* Hodgson, G. W. 02447

Ford, A. B. *See* Brew, David A. 02254

02131 **Ford, Trevor D.; Breed, William J.** The Chuar Group of the Grand Canyon, Arizona [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 23-24, 1969.

02092 **Foster, Helen L.; Clark, Sandra H. B.** Metamorphic rock belt of eastern interior Alaska [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 24, 1969.

Foster, Helen L. *See* Clark, Sandra H. B. 02252

02514 **Foster, Helen L.** Reconnaissance geology of the Eagle A-1 and A-2 quadrangles, Alaska: U.S. Geol. Survey Bull. 1271-G, p. G1-G30, illus., geol. map, 1969.

The Eagle A-1 and A-2 quadrangles are underlain primarily by strongly deformed metamorphic rocks which consist of amphibolite and greenschist facies; the age of the rocks is unknown, but some are Paleozoic. Mesozoic granitic rocks intrude the metamorphics and a mass of serpentinized ultramafic rocks (Paleozoic or Mesozoic) appears to be intrusive. Tertiary sedimentary rocks unconformably overlie the metamorphics in three localities; basalt was erupted after early Tertiary rocks were deposited. The Fortymile River and its tributaries are entrenched, and terraces as high as 500 feet above present streams are conspicuous. Erosion and altiplanation are suggested as processes which formed the relatively uniform surfaces in the southeastern part of A-1. Gold placer mining continues on a small scale on several streams.—*from* Author's abstract

02256 **Foster, R. L.** Nickeliferous serpentinite near Beaver Creek, east-central Alaska, *in* Some shorter mineral resource investigations in Alaska: U.S. Geol. Survey Circ. 615, p. 2-4, illus., table, 1969.

The Beaver Creek alpine-type serpentinite body in the northeastern part of the Livengood ultramafic trend, east-central Alaska, contains nickel concentrations of as much as 0.51 percent and, locally, detectable amounts of platinum and palladium. —Author's abstract

02480 **Fox, Paul J.; Lowrie, Allen, Jr.; Heezen, Bruce C.** Oceanographer Fracture Zone: Deep-Sea Research, v. 16, no. 1, p. 59-66, illus., 1969.

The U.S.C.G.S. *Oceanographer*, using a narrow beam echo sounder and satellite navigation, conducted a 1,500 mile survey of the Mid-Oceanic Ridge at 35° N., 35° W. in an area where the earthquake epicenter belt was offset. The survey revealed that the ridge crest is offset 80 miles in apparent right lateral sense by a steep-walled fracture zone that has a maximum depth of 2400 fms and that strikes N. 75° W. Analysis of magnetometer data showed that the axial growth rate of the ridge on either side of the offset is approximately 1 cm per yr. Serpentinites with lesser amounts of gabbros and basalts were recovered in two dredge hauls from the southern wall of the fracture zone.—Authors' abstract

02093 **Fox, Richard C.** Regional gravity survey of part of the Kaiparowits region, Kane and Garfield Counties, Utah, with profiles across the Paunsaugunt fault [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 24-25, 1969.

02468 **Fox, Sidney W.** Self-ordered polymers and propagative cell-like systems: Naturwissenschaften, v. 56, no. 1, p. 1-9, illus., tables, 1969.

The problem of how life began appears to have a relatively rigorous and simple set of answers. Some of the newer data are reviewed under the headings: earlier proteinoids, new results, internal ordering phenomena, rate enhancement by proteinoids, the first enzymes, hormonal stimulation, photosensitized reactions, the proteinoid microspheres, their budding, prebiological geochemistry, beginning of a coding mechanism, and the way to cellular evolution.—ESL

02268 **Franklin, George J.** First day of field conference, *in* Middle and Upper Pennsylvanian strata in Hopkins and Webster Counties, Kentucky—Geol. Soc. Kentucky, Ann. Spring Field Conf. 1969: [Lexington, Ky.] Kentucky Geol. Survey, p. 20-50, illus., 1969.

In this road log prepared by Williamson, brief descriptions of geology to be seen along the route, mostly in western Hopkins County, are included. Six stops discussed by leader Franklin include: stratigraphic relations of the Carbondale Formation and its No. 9 coal, the most productive in western Kentucky, and No. 10 coal horizon; faults near the Colonial mine where coal Nos. 11-14 and Nos. 6-7 were exposed in stripping operations. Diagrams of sections and borehole logs, as well as photographs of exposures illustrate lithologies and thicknesses of the Carbondale and Lisman Formations. The interval between Nos. 12 and 13 coals, which has been designated as the Conant Limestone, may appropriately be called the Conant Limestone Member of the Lisman Formation.—GDC

02287 **Franklin, George J.** Introduction, *in* Middle and Upper Pennsylvanian strata in Hopkins and Webster Counties, Kentucky—Geol. Soc. Kentucky, Ann. Spring Field Conf. 1969: [Lexington, Ky.] Kentucky Geol. Survey, p. 8-14, illus., 1969.

This review of the regional geology of the Western Kentucky Coal Field includes: a compiled diagram of Pennsylvanian formations with marker beds; geologic columns from four quadrangles, showing generalized lithologies and correlations of Middle and Upper Pennsylvanian strata, and parts to be seen at field-trip stops; and a composite electric log of a portion of the rock sequence. The area was uplifted and faulted after Pennsylvanian deposition and erosion produced a mature topography and left chert-bearing gravels at various levels. Pleistocene blocked dendritic lakes cumulated sediments up to 200 feet thick; erratics were ice-floated into the proglacial lakes. Splendid exposures have been destroyed by the same strip-mining operations that created them.—GDC

02516 **Freeberg, Jacquelyn H.** Terrestrial impact structures—A bibliography, 1965-68: U.S. Geol. Survey Bull. 1320, 39 p., 1969.

This bibliography on impact structures supplements U.S. Geological Survey Bulletin 1220 by citing literature published or reviewed since 1964. It adds 17 new structures to the list of 110 previously considered. It is organized in the same manner as Bulletin 1220.—Author's abstract

02094 **Freethey, G. W.; Waltz, J. P.** Hydrogeologic evaluation of pollution potential at mountain dwelling sites [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 25, 1969.

Friedman, Irving. *See* Long, William. 07549

07541 **Frondel, Clifford; Honea, Russell M.** Billingsleyite, a new silver sulfosalt: Am. Mineralogist, v. 53, nos. 11-12, p. 1791-1798, tables, 1968.

Billingsleyite, $Ag_7(As_{0.86}Sb_{0.14})S_6$, is found at the North Lily mine, East Tintic district, Utah, associated with argentite, tennantite, bismuthinite, galena, and pyrite. The mineral occurs as fine-grained aggregates with a lead-gray color and metallic luster; it is slightly sectile with hardness 2.5. Billingsleyite, isostructural with synthetic Ag_7SbS_6 and synthetic Ag_7AsS_6, is orthorhombic, space group $C222_1$, with $a \sim b \sim 14.8$ A, $c = 10.4$; density $= 5.92 \pm 0.02$ (meas.). The five strongest X-ray powder lines (in A) are: 3.04 (10), 2.48 (8), 2.82 (7), 1.86 (7), and 3.50 (4).—MEM

07548 **Frondel, Clifford; Einaudi, Marco.** Zinc-rich micas from Sterling Hill, New Jersey: Am. Mineralogist, v. 53, nos. 9-10, p. 1752-1754, illus., table, 1968.

Nine electron-probe partial chemical analyses are given for zinc-rich micas from Sterling Hill, N.J., including hendricksite and zincian and manganoan biotite and phlogopite.—MR

02302 **Frye, John C.; Glass, H. D.; Kempton, John P.; Willman, H. B.** Glacial tills of northwestern Illinois: Illinois Geol. Survey Circ. 437, 47 p., illus., 1969.

In northwestern Illinois, outside of the Bloomington-Marengo Moraine, surface tills have been differentiated into eight mappable till units: four Illinoian, two Altonian, and two Woodfordian in age. Differentiation is based on clay-mineral composition, grain size, gross lithology, radiocarbon dates, stratigraphy of overlying loess, and soil profiles. These studies confirm the presence of Altonian drift in the eastern part, indicate Illinoian tills in the northwestern part, and have led to extensive remapping. Intensive erosion during early Woodfordian accounts for the youthful soil profiles. Extent of the Green River Lobe has been restricted; it does not extend westward into Iowa. Earliest Altonian tills are found only in the subsurface in the eastern part and are overlapped by Argyle and younger tills. Sterling till is correlated into subsurface of northeastern Illinois.—*from* Authors' abstract

Frye, John C. *See* Willman, H. B. 02366

07679 **Frye, John C.** Soils, terraces, and pediments in Pleistocene stratigraphy: Kansas Acad. Sci. Trans., v. 71, no. 3, p. 332-338, 1968.

Unique aspects of Pleistocene or Quaternary deposits require techniques and criteria for study not available or useful for older strata. Here considered are: (1) soils, both as surface indicators of glacial regime or weathering conditions, and buried in a sequence of sediments, useful in paleoecology or stratigraphic correlation; (2) constructional forms of alluvial terraces, correlated by sedimentary features; and (3) erosional forms of pediments, often flanking valleys for many miles, but cutting headward progressively older formations. In the approach to the Quaternary, standard stratigraphic rules and criteria applicable to the entire rock sequence are necessary, but the range of criteria can well be augmented by data from soil scientists and geomorphologists.—GDC

Fuchs, Louis H. *See* Bunch, Theodore E. 02202

Fuller, M. *See* Lowrie, W. 02558

Furuta, T. *See* Rhodes, J. R. 07701

07529 **Gaines, Richard V.; Donnay, Gabrielle; Hey, Max H.** Sonoraite: Am. Mineralogist, v. 53, nos. 11-12, p. 1828-1832, tables, 1968.

The new mineral sonoraite, $Fe_2Te_2O_5(OH)_4 \times H_2O$, was found at the Moctezuma tellurium-gold mine in Sonora, Mexico. It resembles emnosite, with which it is associated, but has higher luster and a different habit. There are 4 formula units per cell: $a = 10.984 \pm 0.002$, $b = 10.268 \pm 0.001$, $c = 7.917 \pm 0.002$ A, $\beta = 108.49 \pm 0.02°$, $P2_1/c$, D(calc) = 4.179, D(obs) = 3.95 ± 01 gm/cm³. It is biaxial negative, $\alpha = 2.018$, $\beta = 2.023$, $\gamma = 2.025$, all ± 0.003; 2V ranges from 20° to 25°. The five strongest X-ray powder lines (in A) are: 10.40 (10), 4.66 (8), 3.110 (8), 3.290 (7), and 3.66 (6).—MEM

02179 **Gakiel, U.; Malamud, M.** On the valence of iron in tripuhyite—A Mössbauer study: Am. Mineralogist, v. 54, nos. 1-2, p. 299-301, illus., 1969.

Mössbauer spectra show iron in tripuhyite is ferric, giving the formula $FeSbO_4$. —Authors' abstract

Gangloff, Roland A. *See* McKee, Edwin H. 02054

07648 **García-Calderón, Jorge; Loredo-Murphy, Luis; Trujillo-Candelaria, Antonio.** Carta geológica de México—Hoja El Salado 14 R-j(11): México, D.F., Univ. Nac. Autónoma México, Inst. Geología, scale 1:1,000,000, sections, text, 1968.

Jurassic-Holocene formations of the El Salado area are correlated with those in Texas and northeastern Mexico. Intrusive and metamorphic rocks, tectonics, and geologic history of the area are outlined in the text. Although there is no active mining, possiblities exist for phosphate in the La Caja Formation.—MCM

02095 **Gardner, Leonard Robert.** Age and origin of the Mormon Mesa caliche profile, Clark County, Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 25-26, 1969.

02096 **Gardner, Leonard Robert.** Quaternary geology of the Moapa Valley, Clark County, Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 26, 1969.

07626 **Garland, G. D.** Canadian Geophysical Bulletin, V. 21: Ottawa, Canada, Natl. Research Council Canada Comm. Geodesy and Geophysics, 288 p., 1968.

Canadian activities in geophysics are summarized for the year 1968. Seven of the 10 chapters correspond in discipline to the Associations of IUGG (geodesy and gravity, seismology and physics of the Earth's interior, meteorology, hydrology, geomagnetism and aeronomy, oceanography, and volcanology) with the addition of chapters

on glacier research, isotope studies, and exploration geophysics. Most chapters include a bibliography of publications for the year.—VSN

07634 **Gavasci, Anna T.; Kerr, Paul F.** Uranium emplacement at Garnet Ridge, Arizona: Econ. Geology, v. 63, no. 8, p. 859-876, illus., tables, 1968.

Breccia dikes and collapse areas are associated with ejection vents that originated deep within the basement. Ejectamenta are predominantly metamorphic schist and gneisses. Breccia dike matrix is highly altered, with serpentine and montmorillonite. Garnet, prominent in ejected blocks and breccia dikes, is varied in color and composition according to detailed optical, chemical, and X-ray study. Gases related to deep-seated igneous activity are believed responsible for the intrusions and for the zonally arranged uranium-copper-vanadium deposit in Navajo Sandstone adjacent to one dike.—WSW

02352 **Gedney, Larry; Berg, Eduard.** Some characteristics of the tectonic stress pattern in Alaska: Royal Astron. Soc. Geophys. Jour., v. 17, no. 3, p. 293-304, illus., table, 1969.

Horizontal azimuths of tectonic 'pressure' are plotted for 38 small and intermediate earthquakes recorded in central Alaska from October 1967 to September 1968. Lateral motion on vertical fault planes and normal faulting on vertical or near vertical planes were considered in evaluating P-wave data. Results suggest that maximum tectonic pressure is being exerted in a direction normal to the continental margin in the area of Cook Inlet, while block-faulting is occurring in the northernmost portions of the Alaska Range. Between these two areas, maximum compressive stress is being exerted in a direction parallel to the mountain front, implying that further bending of the range may be occurring. This is the condition which would be expected if this portion of the Alaska Range is performing in the manner of a hinge as in Carey's (1956) 'Alaskan Orocline' theory of continental drift.—*from* Authors' summary

07582 **Gentile, A. L.; Stafsudd, O. M.** Czochralski-grown proustite and related compounds, *in* Crystal growth 1968—Internat. Conf. Crystal Growth, 2d, Birmingham, U.K., 1968, Proc.: Jour. Crystal Growth, v. 3-4, p. 272-274, illus., 1968.

Several ingots of proustite, pyrargite, and tapalptite, as large as 2.4 cm in diameter and 15 cm long, were grown. The method is described in detail.—ESL

George, P. T. *See* Bennett, G. 02570

Gersper, P. L. *See* Holowaychuk, N. 02170

02314 **Geul, J. J. C.** Cloud Bay area (west and east parts), District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Maps P. 529-530, scale 1 in. to 1/4 mi., text, 1969.

Gfeller, P. *See* Haefeli, R. 07699

07700 **Ghisler, Martin.** The geological setting and mineralizations west of Lilianmine, South Greenland: Grönlands Geol. Undersögelse Rap. 16, 53 p., illus., table, geol. map, 1968.

Ketilidian rocks consist of green schists, Julianehaab granite, metamorphosed basic dikes, and the Appinitic intrusive complex of uncertain age. Gardar rocks comprise doleritic and rhyolitic dikes, felsites and quartz porphyries, biotite granite, and pegmatites. Two major fault sets, mainly vertical, may be distingiushed: the first is of early Gardar age; the second, dominant in numbers and influence, strikes N-S and repeated movement has taken place. Two generations of post-Gardar basic dikes are found; a sample from the younger shows that ore minerals form 10 percent of the rock. Field descriptions of copper and magnetite mineralizations and ore microscopy are included. Magnetic surveys have been run, and rock and botanic samples analyzed. The best occurrence of ore is on the coast northeast of Sorttop. The greenschists of the Ivigtut area deserve further study.—ESL

Gibbs, G. V. *See* Ribbe, P. H. 02187

Gibbs, G. V. *See* Brown, G. E. 02189

07558 **Gibbs, G. V.; Grender, G. C.** Inexpensive crystal structure models of framework tetrahedra: Am. Mineralogist, v. 53, nos. 9-10, p. 1738-1740, illus., 1968.

A simple and rapid method for producing large numbers of wire tetrahedra from fence wire, polyvinylchloride tubing, and benders for use in constructing inexpensive crystal structure models of framework tetrahedra is described in detail.—MEM

02401 **Gibson, Thomas G.** Mobility of Atlantic Coastal Plain and shelf abs.]: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 3, p. 719, 1969.

Giguere, J. F. *See* Bennett, G. 02304

Giguere, J. F. *See* Bennett, G. 02305

Giguere, J. F. *See* Bennett, G. 02319

02097 **Giles, David L.** Mineralization related to silicic volcanic centers and terranes [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 27, 1969.

02402 **Gillott, J. E.** Study of the fabric of fine-grained sediments with the scanning electron microscope: Jour. Sed. Petrology, v. 39, no. 1, p. 90-105, illus., 1969.

Micrographs obtained with a scanning electron microscope are used to illustrate the fabrics of some fine-grained limestones and clay soils which have properties of special engineering interest. Fine structure is revealed with unusual clarity. Of particular interest are: the nature of contacts of fine-grained crystals with one another and with coarser crystals, particularly dolomites; the disposition of the noncarbonates, and/or cementitious material along grain boundaries; and the orientation of mica-type minerals in shales, mudstones, and clay soils. The relative merit of several methods of sample preparation is discussed.—*from* Author's abstract

02098 **Gilmour, Ernest H.** Geology of the southeastern part of the Big Snowy Mountains, Montana [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 27, 1969.

Givens, W. W. *See* Hilchie, D. W. 02358

07697 **Glancy, Patrick A.** Water-resources appraisal of Butte Valley, Elko and White Pine Counties, Nevada: Nevada Div. Water Resources, Water Resources-Reconn. Ser. Rept. 49, 50 p., illus., tables, 1968.

Precipitation within Butte Valley in east-central Nevada is assumed to be the main source of water supply to the valley-fill reservoir; however, carbonate rocks, prevalent in the region, may be highly transmissive locally. Principal known aquifers occur in valley fill at generally shallow depths. However, only about 20 wells have been drilled and no data are available regarding deeper parts of the fill. The carbonate rocks also constitute an unexplored but probably significant ground-water system. Chemical analyses of water from 21 well, spring, and stream sources show very good quality of water.—*from* Author's abstract

02132 **Glass, Charles E.; Slemmons, David B.** Restudy of surface faulting from the October 2, 1915, Pleasant Valley area earthquake, Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 28, 1969.

Glass, H. D. *See* Frye, John C. 02302

07684 **Glover, Robert K.; Tomanek, G. W.; Wolters, Gale L.** Soil and vegetation relationships on four slopes of the Ogallala Formation in Trego County, Kansas: Kansas Acad. Sci. Trans., v. 71, no. 1, p. 69-84, illus., 1968.

Vegetation and soils were studied on a large hill rising abruptly from a level plain in Trego County; soil profile descriptions were made on top of the hill and on upper and lower slopes facing north, south, east, and west. Soils are forming in calcified, highly calcareous, old alluvium of the Ash Hollow member of the Pliocene Ogallala Formation; they are quite similar in relation to slope direction, but soils of the upper slopes are shallower than those on the lower slopes. Distribution of the grasses indicates that the most mesic slope is north facing, followed in order by the east, west, and south facing slopes. Longitudinal sections show soil profile development in relation to lithologic horizons in the hill.—GDC

Goebel, Edwin D. *See* Jewett, John Mark. 07665

Goforth, Tom T. *See* McDonald, John A. 02510

Gold, D. P. *See* Deines, P. 02445

02503 **Goldreich, Peter; Toomre, Alar.** Some remarks on polar wandering: Jour. Geophys. Research, v. 74, no. 10, p. 2555-2567, illus., 1969.

Three contributions are presented which lend fresh support to the hypothesis that large angular displacements of the Earth's axis of rotation relative to the entire mantle have occurred on a geologic time scale, owing to the gradual redistribution (or decay or manufacture) of density inhomogeneities within the Earth by the same convective processes responsible for continental drift: (1) A pedagogic theorem rigorously illustrates this mechanism of polar wandering for a "quasi-rigid body." (2) The notion is refuted that the Earth's figure shows signs of a faster spin rate in the past. (3) The triaxial ellipsoid shape is to be expected of any randomly evolving, nearly spherical object without too much "memory" for its past axis of rotation; some statistical aspects of polar wandering are discussed on the assumption that the Earth is such an object.—DBV

02088 **Goode, Harry D.** Geoevolutionism—A step beyond catastrophism and uniformitarianism [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 29, 1969.

02133 **Goode, Harry D.** Estimated potential of Navajo Sandstone as an aquifer west of Escalante anticline, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 28, 1969.

Goodspeed, Robert M. *See* Vogel, Thomas A. 07572

02403 **Gordon, Mackenzie, Jr.; Stone, Charles G.** New evidence for dating Carboniferous flysch deposits of Ouachita geosynclines, Arkansas and Oklahoma [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 3, p. 719, 1969.

02545 **Gordon, Mackenzie, Jr.** Early Pennsylvanian ammonoids from southern Nevada: U.S. Geol. Survey Prof. Paper 613-C, p. C1-C13, illus., 1969.

Five species of late Morrow ammonoids are described from the basal part of the Pennsylvanian sequence in the foothills of the Spring Mountains, northern Clark County and in the Nevada Test Site, southern Nye County, Nevada. Lower Morrow and uppermost Mississippian deposits are absent in this region, where an unconformity separates Upper Mississippian and Lower Pennsylvanian rocks. Four species characterize the *Diaboloceras peroccidens* Zone. This assemblage is the same age as that of the middle part of the Bloyd Shale in the type section of the Morrow Series in Arkansas.—MG

Gorman, Helen. *See* Stanton, R. L. 07637

02183 **Graf, Donald L.** Crystallographic tables for the rhombohedral carbonates—A correction [to 1961 paper]: Am. Mineralogist, v. 54, nos. 1-2, p. 325, 1969.

Dr. Friedrich Lippmann of the University of Tübingen has pointed out that the oxygen x parameter for dolomite used in an earlier paper (Graf, 1961) is in error. The parameter should be 0.2474 ± 0.0068 instead of 0.2374 ± 0.0068. The latter value was an undetected typesetting error in Steinfink and Sans (1959). The oxygen amplitude contributions for dolomite and errors in calculated intensities in tables and a figure are also wrong. Because of the availability of computer programs for generating this information, the author does not intend to prepare corrected tables.—ESL

02578 **Grant, Alan Robert.** Chemical and physical controls for base metal deposition in the Cascade Range of Washington: Washington Div. Mines and Geology Bull. 58, 107 p., illus., tables, 1969.

The Range is primarily a copper province, with marked parallelism of physical conditions for sulfide deposition. Environmental criteria are: adjacent or subjacent high-level intrusive activity subsequent to metamorphism, transverse northeast-trending structural belts cutting the northwest regional trend, and K-silica wall rock alteration. The North Cascades are composed of pre-Tertiary metamorphic rocks, and the central part, of early to middle Tertiary volcanic rocks and subordinate sedimentary rocks, also intruded by Tertiary calc-alkaline igneous rocks. Although the intrusions are mainly quartz-dioritic, later-stage differentiates of quartz monzonite and granite are common. Emplacement was partly controlled by transverse structural activity. Sulfide concentrations are partly dependent on degree of acidic intrusive activity and intensity of transverse structural deformation.—*from* Author's abstract

Gravlee, George C., Jr. *See* Scott, Kevin M. 07531

Greenland, L. P. *See* Anderson, A. T. 02449

02453 **Greenwood, J. Arthur; Nathan, Alan; Neumann, Gerhard; Pierson, Willard J.; Jackson, Frederick C.; Pease, Thomas E.** Oceanographic applications of radar altimetry from a spacecraft: Remote Sensing Environment, v. 1, no. 1, p. 71-80, illus., table, 1969.

Oceanographic applications to the study of radar altimetry from a spacecraft to the study of sea-surface slopes, tides, tsunamis, and storm surges, and to submarine geology are discussed.—*from* Authors' introduction

02089 **Greenwood, William R.** Reconnaissance structural analysis of metasediments bordering the Union Bay zoned ultramafic complex, southeastern Alaska [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 29, 1969.

Grender, G. C. *See* Gibbs, G. V. 07558

02090 **Gries, J. P.; Niven, David; Crooks, T. J.** Geohydrology of the Pahasapa (Madison) Limestone at and near the outcrop, Black Hills, South Dakota [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 30, 1969.

Griffin, Margaret S. *See* Weld, Betsy A. 02355

07588 **Griffiths, John C.; Ondrick, Charles W.** Sampling a geological population: Kansas Geol. Survey Computer Contr. 30, 53 p., illus., tables, 1968.

A geological population is characterized by describing certain properties of its individual elements. Different results that arise from various sampling arrangements are illustrated. The objective is to determine the mean, and dispersion around it of specified characteristics; this entails determining statistical estimators of the required population parameters. The second step is to select the characteristic parameters to estimate. Sampling and measurement procedure and data analysis are discussed; the Montoursville gravel, Pennsylvania, is used as an example. Systems Program One (univariate analysis, pebble size) and (bivariate analysis, pebble shape) are given and compared with other methods.—ESL

Griswold, D. H. *See* Holland, J. L. 02086

Grommé, C. S. *See* Merrill, R. T. 02407

02494 **Grossling, B. F.** Color mimicry in geology and geophysics: Geophysics, v. 34, no. 2, p. 249-254, 1969.

Color mimicry consists of preparing, by optical and photographic means, a color synthesis of two or three pictures of the same object or scene. The superposition of the projected images on a screen synthesizes the three fields into a pattern of hues, which can disclose correlations among them that may be difficult to grasp otherwise. To each of the pictures one primary color is assigned by using a color filter. Color mimicry experiments were carried out on pictures of Kilauea volcano in Hawaii. Color mimicry brings to the visible spectrum the information content of other bands of the electromagnetic spectrum and allows the brain to correlate them as it does within the visible band.—KAF

Grossman, I. G. *See* Thomas, Chester E., Jr. 07642

07539 **Grybeck, Donald; Finney, J. J.** New occurrences and data for jalpaite: Am. Mineralogist, v. 53, nos. 9-10, p. 1530-1542, tables, 1968.

Five specimens of jalpaite from four new localities were identified and examined. Jalpaite from Silver Plume, Colo., of ideal composition Ag_3CuS_2, is tetragonal, space group $I4_1/amd$ with $a = 8.633$, $c = 11.743$ A and $Z = 8$; Dx 6.827, Dm 6.82 ± 0.01; and from Boulder County, Colo., Dm 6.85. The range in the calculated density 6.827 g/cm^{-3} for Ag_3CuS_2 to 6.920 g/cm^{-3} for $Ag_{1.55}Cu_{0.45}S$ may serve as a measure of the jalpaite composition. The five strongest powder lines (in A) are: 2.345 (10)(321), 2.794 (9)(301), 2.740 (8)(213), 2.422 (8)(204), 2.114 (7)(224).—MEM

Gude, Arthur J., 3d. *See* Sheppard, Richard A. 02200

Gupta, Yugal. *See* Overton, Harold L. 02359

Gutschick, R. C. *See* Sandberg, Charles A. 02232

Guy, H. P. *See* Stringham, G. E. 02261

07699 **Haefeli, R.; Brandenberger, F.; Gfeller, P.** Rheologisch-glaziologische Untersuchungen im Firngebiet des grönländischen Inlandeises [with English abs.]: Medd. Grönland, v. 177, no. 1, 340 p., illus., tables, 1968.

Results of rheologic-glaciologic investigations, mainly at Jarl-Joset Station, of the International Glaciological Greenland Expedition in 1957-60, are presented. Section 1 (4 chapters) describes methods, apparatus, and instruments used and results obtained from determination of mechanical properties of firn in situ. Section 2 (6 chapters) concerns glaciological evaluation of individual results. Viscosity properties of the relatively fluid polar firn lying above the polar ice, glaciologic interpretation of the W-E profile, and displacement measurements including deformation quadrilaterals are discussed. Comparison of results with predictions shows good agreement. Calculations are made of the ice age. A laboratory test with plate-gap model proves the theoretically calculated streamlines and demonstrates the state of ice motion.—*from* Authors' abstract

Haffty, Joseph. *See* Page, Norman J. 02467

02361 **Hails, J. R.; Hoyt, J. H.** An appraisal of the evolution of the lower Atlantic Coastal Plain of Georgia, U.S.A.: Inst. British Geographers Trans., no. 46, p. 53-68, illus., table, 1969.

The Quaternary history of the lower Atlantic Coastal Plain of Georgia is outlined and problems in establishing late Pleistocene eustatic changes of sea-level are examined. The area was relatively stable during Quaternary and may be a key to eustatic changes of sea-level. The marine and transitional sediments studied parallel the modern coast in an area about 90 km wide. Sediments were deposited in a barrier-island environment, and are usually 10-20 m thick but may be up to 40 m thick. Bar-

riers are well sorted fine to medium sand; lagoons are sediment filled and occupied by salt marshes traversed by deep meandering tidal creeks. Seven sequences of Quaternary barrier have been mapped below an altitude of 31 m, each representing a period of submergence. Quaternary sea-level fluctuations are superimposed on a general emergence.—VSN

Hamilton, J. C. *See* Sainsbury, C. L. 07650

02551 **Hamilton, W. B.** Geology of the Colorado Desert (Salton Trough): California Div. Mines and Geology Mineral Inf. Service, v. 22, no. 6, p. 96-98, illus., reprinted 1969; originally published 1966.

Reprinted with illustrations, this paper was published originally in U.S. Cong., 89th, 2d Sess., Comm. Interior and Insular Affairs, Comm. Print (California Div. Mines and Geology Bull. 191), p. 73-76, 1966.—MCM

07591 **Handy, R. L.** The Pleistocene of Iowa—An engineering appraisal: Iowa Acad. Sci. Proc. 1968, v. 75, p. 210-224, illus., tables, 1968.

Pleistocene deposits from wind, water and ice dominate the soil engineering in Iowa. For foundation engineering the *in situ* properties of soils must be evaluated, the most pertinent properties being shear strength and compressibility. Alternately if the soil is to be used as construction material, for example in embankment or earth dam construction, disturbed properties such as grain size and plasticity are utilized and are reflected in engineering classification. The shear strength, compressibility, and engineering classification of the various types of Pleistocene and Recent deposits in Iowa are presented and discussed, and examples of the use of shear strength data in slope stability and bearing capacity problems are presented.—Author's abstract

02091 **Hansen, Wallace R.** Tertiary drainage development across the Uinta Mountains—A review [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 30-31, 1969.

02330 **Hansen, Wallace R.** The geologic story of the Uinta Mountains: U.S. Geol. Survey Bull. 1291, 144 p., illus., 1969.

The history of exploration, geomorphology, stratigraphy, structural geology, and geologic history of the Uinta Mountains region are summarized in this nontechnical account. Major chapters are the landscape and its attributes, time and the rocks, geologic structure, what the future holds, and a few words about animals.—VSN

Harada, Kazuo. *See* Iijima, Azuma. 02194

07587 **Harbaugh, J. W.; Sackin, M. J.** FORTRAN IV program for harmonic trend analysis using double Fourier series and regularly gridded data for the GE 625 computer: Kansas Geol. Survey Computer Contr. 29, 30 p., illus., tables, 1968.

This publication is one in a series on trend-analysis programs, and will be of interest to those who wish to analyze data suspected of containing oscillatory phenomena. The FORTRAN IV program is a translation of an earlier BALGOL program; it computes coefficients of Fourier series, evaluates and plots the function, and computes and plots residual values.—ESL

02506 **Hargraves, R. B.; Perkins, W. E.** Investigations of the effect of shock on natural remanent magnetization: Jour. Geophys. Research, v. 74, no. 10, p. 2576-2589, illus., tables, 1969.

Results of a reconnaissance study of samples from the rim of Meteor Crater, Ariz., rocks from the Nevada Test Site, and basalts shocked in the laboratory suggest that in rocks in which magnetite or titanomagnetite is the dominant ferrimagnetic constituent, shock pressures >5 kb may have a substantial demagnetizing effect on the natural remanent magnetization. Further, shock may induce a distinct anhysteretic remanence component, the intensity and direction of which is a function of the am-

bient field. The bulk susceptibility of granodiorite apparently is lowered by shock. The intensity of the shock effect varies with rock type (it is negligible in the Moenkopi red beds around Meteor Crater) and with magnitude of the pressure pulse; a stable remanent component may survive, however, and could be recovered from the effects of all but the most severe shock.—DBV

Harp, E. L. *See* Bailey, R. L. 02122

02311 **Harris, F. R.** Watten Township (east and west halves), District of Rainy River: Ontario Dept. Mines Prelim. Geol. Maps P. 522-523, scale 1 in. to 1/4 mi., text, 1969.

Harshman, E. N. *See* Denson, N. M. 02456

02134 **Harthill, Norman.** An electrical resistivity survey of the Wolcott landslide, Colorado [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 31, 1969.

Harvey, E. J. *See* Feder, G. L. 02340

02379 **Harward, M. E.; Carstea, D. D.; Sayegh, A. H.** Properties of vermiculites and smectites—Expansion and collapse [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 6, p. 437-447, illus., tables, 1969.

Samples were evaluated to determine effects of source and amount of charge and if a continuum of properties exists, and to improve the basis for differentiating criteria for identification. Montmorillonites expanded to the two-layer complex with solvation of ethylene glycol or glycerol vapor. Beidellite exhibited the one-layer complex with glycerol and two-layer with ethylene glycol. Vermiculite yielded different complexes depending on conditions of solvation. K-saturated vermiculites and smectites both exhibited collapsed layers in a dry atmosphere. Hydration of smectites occurred at humidities above 20 percent. K-saturated vermiculites tended to retain the collapsed lattice, but some hydration occurred. Differences in properties can be related to source and amount of charge; but a continuum in properties between the two minerals was not observed. Data indicate two discrete populations.—*from* Authors' abstract

Hashimoto, T. *See* Eakins, P. R. 07689

Hastings, Earl L. *See* Daniel, Thomas W., Jr. 07645

Hathaway, J. C. *See* Christ, C. L. 02195

07511 **Hatheway, Allen W.** Subsidence at San Manuel copper mine, Pinal County, Arizona: Geol. Soc. America Eng. Geology Case Histories, no. 6, p. 65-81, illus., 1968.

Although subsidence is directly caused by withdrawal of ore from underground workings, the particular combination of rock type, geologic structure, and method of mining at a site is responsible for the physical character of subsidence at the surface. Three large subsidence pits occur in a wedge-shaped caprock of Tertiary conglomerates, and have a total surface area exceeding 160 acres. Peripheral growth of the pits is controlled by geologic structure and engineering properties of the caprock and ore body, as well as by the relative location of caved blocks and rate of withdrawal of ore. Specific items of interest at the site are numerous subparallel faults, a definite pattern of advancing ground fractures, and well-defined units of mass wastage within the pits. There are definite relations between geologic structure and growth and configuration of the subsidence pits.—*from* Author's abstract

07617 **Haught, Oscar L.** Structural contour map, datum Greenbrier Limestone in West Virginia: [Morgantown, W.Va.] West Virginia Geol. and Econ. Survey, scale 1:500,000, text, 1968.

Exposed sections of the Greenbrier Limestone, of Middle Mississippian age, reach a maximum thickness of 1,800 feet at the extreme south and thin northward to about 110 feet. The "Big Lime" of well records is usually all Greenbrier, but does not always include the entire Greenbrier section locally present. The productive beds logged as "Blue Monday" and "Keener" sands are everywhere parts of the Greenbrier, as is generally a part or all of the "Big Injun" sand. Production is also obtained from oolitic and dolomitic beds in the more strictly calcareous parts of the Greenbrier, mostly in the southwestern section. Areas productive of gas are quite large, but oil production is confined to small scattered areas.—MCM

02253 **Hawley, C. C.; Martinez, E. E.; Marinenko, John.** Geochemical data on the South ore zone, White Mountain mine and on the gold content of other mercury ores, southwestern Alaska, *in* Some shorter mineral resource investigations in Alaska: U.S. Geol. Survey Circ. 615, p. 16-20, illus., table, 1969.

Mercury ores of southwestern Alaska generally contain only trace amounts of gold or are gold free. Gold was detected in one new sample from the South ore zone, and it exists in near-crustal-background to anomalous amounts in at least six other widely scattered prospects that had been sampled previously. Only one sample, from Cinnabar Creek mine, contained more than 0.10 ppm gold, and none was detected in three samples from the Red Devil mine, the most productive mercury deposit of the region. Although ore at the White Mountain mine has a sparsity of trace elements except mercury, the fault gouge in the main vein, the South ore zone, has anomalous amounts of Ti, As, Sb, B, Cr,and Zr. Similar compositions of fault gouge elsewhere in the region may be a guide to mineralized areas.—*from* Authors' abstract

02458 **Hawley, C. C.; Clark, Allen L.; Herdrick, M. A.; Clark, Sandra H. A.** Results of geological and geochemical investigations in an area northwest of the Chulitna River, central Alaska Range: U.S. Geol. Survey Circ. 617, 19 p., illus., tables, 1969.

Paleozoic and Mesozoic sedimentary and volcanic rock units, faults, and elongate bodies of intrusive rock, particularly serpentinites, have a dominant northeasterly trend northwest of the Chulitna River. The serpentinites locally contain abnormal concentrations of nickel, have one newly identified occurrence of chromite, and are hosts to small epigenetic lodes containing copper, gold, and silver. Other epigenetic concentrations of copper or other metals occur in interlayered basalt and limestone and in porphyry. Tin occurs in several localities; mineralized rocks characterized by silver, lead, and zinc crop out near Lookout Mtn. Anomalous concentrations of gold and other metals occur in stream sediments and in several areas near known lode mineral occurrences.—*from* Authors' abstract

02182 **Heald, E. F.; Reeher, J. R.; Herrington, D. R.** Gel preparation of starting materials in iron-containing silicate systems: Am. Mineralogist, v. 54, nos. 1-2, p. 317-320, 1969.

A solution of ferric benzoate in N,N-dimethylformamide may be used as a source of iron in the gel method of preparing starting materials in the system MgO-SiO_2-Fe-O. —Authors' abstract

02498 **Hearst, J. R.; Carlson, R. C.** The RIDS—A density logger for rough holes: Geophysics, v. 34, no. 2, p. 222-234, illus., table, 1969.

The RIDS (rugosity-insensitive density system), a gamma-gamma system that can operate in very rough boreholes by virtue of special sensors that make contact with the walls of the hole, has been tested over a density range of 0.6 to 2.6 g per cu cm in the field. Error is believed to be less than $\pm$ 2.5 percent over much of the range. Tight collimation and energy discrimination limit detection to singly Compton-scattered gamma energy. Substantial errors in density measurements can occur in other logging systems, in particular where the hole is rough enough to cause gaps between the sonde and the wall; such errors can range from 4 to 25 percent for only a 1-cm gap between sonde and wall. RIDS results agree within a few percent with those of other logging systems where the latter are not perturbed by gaps between sonde and wall, and with core data when available.—*from* Authors' abstract

02283 **Heckel, Philip H.; Cocke, J. M.** Phylloid algal-mound complexes in outcropping Upper Pennsylvanian rocks of mid-continent: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 5, p. 1058-1074, illus., 1969.

A phylloid algal-mound complex is a local or subregional thickening of limestones attributed chiefly to the presence of leaflike or phylloid algae. Twenty-three such complexes are present at or near the southern ends of most limestone units of Missouri and Virgil age (Upper Pennsylvanian) in eastern Kansas, northeastern Oklahoma and northwestern Missouri. The complexes consist of two distinctive facies that resulted from algal growth on topographic highs. These highs were situated between a region of clastic influx and the open sea, and the algae proliferated and produced sufficient sediment to compensate for subsidence.—*from* Authors' abstract

02434 **Hedberg, Hollis D.** Who should have jurisdiction over offshore mineral resources?: Oil and Gas Jour., v. 67, no. 21, p. 128-132, 1969.

This paper summarizes a National Petroleum Council report on ocean-bed jurisdiction which concludes that the most reasonable interpretation of the Geneva Convention on the Continental Shelf and a consideration of all legal, political, economic and scientific realities, combine to make the base of the continental slope the optimum general guide to the outer boundary of exclusive coastal state jurisdiction over ocean bottom resources.—HHA

Hedge, C. E. *See* Doe, B. R. 07636

Heezen, Bruce C. *See* Fox, Paul J. 02480

02083 **Heidrick, Tom L.; Rehrig, William A.** The influence of regional fracture systems on the localization of porphyry copper mineralization, Basin and Range, Arizona [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 31, 1969.

Heidrick, Tom L. *See* Rehrig, William A. 02250

Henderson, Bonnie C. *See* Downs, George R. 02440

Henderson, C. M. B. *See* Taylor, D. 07571

Hendricks, J. D. *See* Sutton, R. L. 02145

07671 **Henoch, W. E.; Stanley, A.** (compilers). Glacier map of northern Queen Elizabeth Islands (District of Franklin)—IWB 1003: Ottawa, Ontario, Canada Dept. Energy, Mines and Resources, scale 1:1,000,000, 1968.

07672 **Henoch, W. E.; Stanley, A.** (compilers). Glacier map of southern Queen Elizabeth Islands (District of Franklin)—IWB 1004: Ottawa, Ontario, Canada Dept. Energy, Mines and Resources, scale 1:1,000,000, 1968.

07673 **Henoch, W. E.; Stanley, A.** (compilers). Glacier map of northern Baffin Island (District of Franklin)—IWB 1005: Ottawa, Ontario, Canada Dept. Energy, Mines and Resources, scale 1:1,000,000, 1968.

07674 **Henoch, W. E.; Stanley, A.** (compilers). Glacier map of southern Baffin Island (District of Franklin) and northern Labrador Peninsula (Quebec and Newfoundland)—IWB 1006: Ottawa, Ontario, Canada Dept. Energy, Mines and Resources, scale 1:1,000,000, 1968.

Herdrick, M. A. *See* Hawley, C. C. 02458

02496 **Hermont, A. J.** Is seismic energy of diagnostic value?: Geophysics, v. 34, no. 2, p. 196-212, illus., table, 1969.

Since intensity of a seismic wave and its energy density are directly related to the square of particle velocity, energy density recorded as a function of time and space is a function of spatial attenuation factors of the media traversed, partition at reflection

boundaries, and geometric spreading. A function may be generated that is diagnostic of attenuation properties of the geologic model, and may be useful for lithologic interpretation. A quantity proportional to the logarithm of the peak absolute value of the square of the particle velocity, or logarithm of energy density, was recorded along test profiles; conventional reflection data were also recorded. Seismic energy is of diagnostic value, but it is necessary to develop techniques to remove geometric and reflectivity effects from recorded energy data, to eliminate measurement errors producing magnitude errors of several orders, and to develop a detailed and accurate set of in-situ spatial attenuation factor data.—KAF

02272 **Hernon, Robert M.** The Wehutty Formation of North Carolina, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1967: U.S. Geol. Survey Bull. 1274-A, p. A49-A52, 1969.

Heron, S. Duncan, Jr. *See* Colquhoun, D. J. 02356

02357 **Heron, S. Duncan, Jr.** Mineralogy of the Black Mingo mudrocks: South Carolina Div. Geology Geol. Notes, v. 13, no. 1, p. 27-41, illus., tables, 1969.

The mudrocks of this lower Tertiary formation of South Carolina have been studied by X-ray diffraction, dilatometry, and electron microscopy. Their main constituents are montmorillonite, a disordered opal, detrital quartz, clay mica, and a trace of kaolinite. A few samples in both the subsurface and surface have small quantities of the zeolite clinoptilolite, and one sample contains a little phillipsite. The purest opal is found in outcrops without any zeolite; the less pure in the subsurface associated with zeolites derived from volcanic ash. The opal has been derived from both ash and decomposing zeolites. Some of the montmorillonite associated with the opal may have been derived from volcanic ash. It appears that volcanic ash and its derivatives are an important constituent of lower Tertiary sediments in the Southeast. Possible sources of the ash are discussed.—*from* Author's abstract

Herrington, D. R. *See* Heald, E. F. 02182

07606 **Hershey, Robert E.** Mineral resources summary of the Adams quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 5 p., 1968.

The only mined resource in the Adams quadrangle is limestone, outcrops of which are very sparse; the St. Louis and Warsaw Formations are the only formations that contain desirable limestone. Gravel is a minor potential resource. This text accompanies Tennessee Div. Geology Geol. Map GM 303-SE by G. K. Moore and M. V. Marcher (cited separately).—MCM

07607 **Hershey, Robert E.** Mineral resources summary of the Springfield North quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 22 p., tables, 1968.

Resources mined in the Springfield North quadrangle are limestone, mainly from the St. Louis and Warsaw Formations, and their residual chert. Of the 33 oil and gas tests drilled, three have produced small quantities of oil and seven have produced some gas. This summary accompanies Tennessee Div. Geology Geol. Map GM 306-SW by G. K. Moore (cited separately).—MCM

07608 **Hershey, Robert E.** Mineral resources summary of the Youngville quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 12 p., tables, 1968.

The only mined resource in the Youngville quadrangle is limestone mainly from the St. Louis and Warsaw Formations. Nine unsuccessful test wells have been drilled for oil and gas, one of which encountered zinc mineralization. A minor potential resource is chert. This summary accompanies Tennessee Div. Geology Geol. Map GM 306-SE by G. K. Moore and C. W. Wilson, Jr. (cited separately).—MCM

02336 **Herzenberg, C. L.; Riley, D. L.** Oxidation states and site symmetries of iron in ilvaite using Mössbauer spectrometry: Acta Cryst., v. A25, pt. 2, p. 389-391, illus., 1969.

The Mössbauer spectrum of ilvaite has been measured at room temperature, and indicates the presence of both high-spin ferrous and ferric iron. Two distinguishable ferrous sites are detected, with the proportion of Fe^{2+} ions differing by about 20 percent. The ferric site is highly distorted.—Authors' abstract

Hey, Max H. *See* Gaines, Richard V. 07529

02452 **Hickman, G. Daniel; Hogg, John E.** Application of an airborne pulsed laser for near shore bathymetric measurements: Remote Sensing Environment, v. 1, no. 1, p. 47-58, illus., 1969.

Results of preliminary transmission measurements made in a water tank using a 3-nsec pulsed neon laser were used in the design of airborne tests to investigate deployment of a pulsed blue-green laser as an airborne bathymetric sensor for nearshore beach reconnaissance over the shores of Lake Ontario. Water depths up to 26 feet were recorded. Maximum depth capability is limited to approximately four attenuation lengths at a platform altitude of 500 feet; in fairly clear water this amounts to a depth-measuring capability of 120 feet. Shallow-water resolution is ± 1.5 feet. An operational system employing a high-power high-pulse rate laser (100-1000 pps) could operate from either a helicopter or a high-performance aircraft and sweep out a broad area coverage. An aircraft flying at 300 mph could obtain data points every 20 feet over an area of 5-50 sq mi/hr.—*from* Authors' abstract

High, Lee R., Jr. *See* Picard, M. Dane. 02244

02262 **High, Lee R., Jr.; Picard, M. Dane.** Stratigraphic relations within upper Chugwater Group (Triassic). Wyoming: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 5, p. 1091-1104, illus., 1969.

Application of physical criteria to regional stratigraphy of the Chugwater Group (Triassic) in Wyoming establishes well-defined lithologic correlations of units; these physical correlations permit more complete reconstruction of paleogeography and subsequent tectonic events, and demonstrate the interpretive significance of red beds. Correlations of the Crow Mountain, Popo Agie, and Jelm Formations, and lithologic correlation of the Popo Agie and Jelm with the Ankareh, exploit the thin but widespread, laterally persistent nature of these rock units and lends new continuity to the geologic history of the Triassic Wyoming shelf.—BHK

02358 **Hilchie, D. W.; Mills, W. R.; Dennis, C. L.; Givens, W. W.** Some aspects of pulsed neutron logging: Log Analyst, v. 10, no. 2, p. 7-17, illus., table, 1969.

This paper is a critical review of the problems confronting thermal pulsed neutron (lifetime) logging today. To achieve a good interpretation, the log analyst must be aware of the 'physics' of the tool operation as well as the nominal sources of error; the latter are a function of the location of the time windows, depth of investigations of the measurement, statistical uncertainties and source-to-detector spacing. A quantitative interpretation of existing tools requires more than a simple reading of well log curves and formulas. The commercial pulsed neutron logs are doing a good job and afford information previously not obtainable. Pulsed neutron logging is in its infancy and future improvements and refinements will materially improve ability to locate hydrocarbons.—*from* Authors' abstract

Hildreth, R. A. *See* Barker, Fred. 02126

Hill, T. R. *See* Eckhoff, N. D. 07676

07547 **Hill, V. G.; Chang, Luke L. Y.** Hydrothermal investigation of GeO_2: Am. Mineralogist, v. 53, nos. 9-10, p. 1744-1748, illus., table, 1968.

Experimental studies in the system GeO_2-H_2O from 500 to 1500 psi P_{water} and 900° to 1150°C delineate the stability fields of rutile-type GeO_2, quartz-type GeO_2, and liquid. A triple point at which the GeO_2 polymorphs and liquid are in equilibrium exists at 1083°C and 1100 psi P_{water}.—BAM

02084 **Hintze, Lehi F.** Normal faults in the Wasatch Range at Provo,Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 32, 1969.

02490 **Hitchon, Brian.** Fluid flow in the western Canada sedimentary basin—[Pt.] 2, Effect of geology: Water Resources Research, v. 5, no. 2, p. 460-469, illus., 1969.

The effect of variations of geology on the fluid potential distribution is treated by considering the three-dimensional flow net by stratigraphic units. Hydraulic head distribution maps for 27 stratigraphic units were prepared and four are illustrated. The low fluid-potential drain that exists within the Upper Devonian and Carboniferous carbonate rocks contain drainage channels belonging to different fluid potential subsystems like the reef complexes of the Beaverhill Lake Formation and Woodbend Group. Drawdown of fluid potentials by low fluid-potential channels is reflected through 2500 feet of strata and across a major unconformity. Relatively highly permeable beds significantly affect regional fluid potential distribution, although the dominant features are topographically controlled.—*from* Author's abstract

Hite, Robert J. *See* Mutschler, Felix E. 02039

Hoadley, J. W. *See* Armstrong, J. E. 02549

Hoare, J. M. *See* Clark, Sandra H. B. 02252

02388 **Hobson, George D.; Terasmae, J.** Pleistocene geology of the buried St. Davids Gorge, Niagara Falls, Ontario—Geophysical and palynological studies: Canada Geol. Survey Paper 68-67, 16 p., illus., table, 1969.

Stratigraphic drilling has verified geophysical delineation of the buried ancient Niagara River valley from the present Whirlpool to St. Davids and north to Lake Ontario. Refraction seismic profiles show the bedrock channel bifurcates east of Virgil, where a branch extends northeast to the Niagara River. Calculated depths in excess of 150 feet below surface result in a mile-wide channel cut 80 feet deep into bedrock. No fossils were found in boreholes below the Niagara escarpment, but in St. Davids Gorge one revealed pollen and plant macrofossils at a depth of 106-183 feet in nonglacial sediments of late mid-Wisconsin age, overlain by glacial deposits. Wood from the 150-ft level was carbon-dated at 22,800 ± 450 years; pollen assemblages indicate a cold climate, and confirm cutting of St. Davids Gorge during the last interglacial interval or earlier.—GDC

07621 **Hodges, Arthur L., Jr.; Butterfield, David.** Ground water favorability map of the West-Deerfield River basin, Vermont: [Montpelier, Vt.] Vermont Dept. Water Resources, scale about 1 in. to 2 mi., text, 1968.

Areas underlain by thick deposits of coarse-grained stratified glacial drift have the greatest potential for ground-water development; these are along the Winhall River and the West River from Weston to South Londonderry, Jamaica to Brattleboro, and along the Marlboro Branch. For more detailed appraisal, further studies are recommended.—MCM

07622 **Hodges, Arthur L., Jr.; Butterfield, David.** Ground water favorability map of the White River basin, Vermont: [Montpelier, Vt.] Vermont Dept. Water Resources, scale about 1 in. to 2 mi., text, 1968.

The areas of greatest ground-water potential are along the main stem of the White River from Granville to Bethel and in the towns of Sharon and Hartford; excellent potential is indicated also along parts of the Tweed River and the Second and Third branches of the White River. These areas are underlain by thick deposits of coarse-grained stratified glacial drift. Further studies are recommended for a more detailed appraisal.—MCM

07623 **Hodges, Arthur L., Jr.; Butterfield, David.** Ground water favorability map of the Wells-Ompompanoosuc River basin, Vermont: [Montpelier, Vt.] Vermont Dept. Water Resources, scale about 1 in. to 2 mi., text, 1968.

The most favorable areas for ground-water development—those underlain by thick deposits of coarse-grained stratified glacial drift—are along parts of the Connecticut, Wells, Waits, and Ompompanoosuc Rivers. Silt and clay limit the potential of portions of the Connecticut River. A more detailed appraisal of the area would require further studies.—MCM

07624 **Hodges, Arthur L., Jr.; Butterfield, David.** Ground water favorability map of the Ottauquechee-Saxtons River basin, Vermont: [Montpelier, Vt.] Vermont Dept. Water Resources, scale about 1 in. to 2 mi., text, 1968.

Although further studies are needed for a more detailed appraisal of ground-water availability, preliminary work indicates that the areas of greatest potential are along the Ottauquechee, Black, Williams, and Saxtons Rivers, where there are thick deposits of coarse-grained stratified glacial drift.—MCM

02447 **Hodgson, G. W.; Flores, Jose; Baker, Bruce L.** The origin of petroleum porphyrins—Preliminary evidence for protein fragments associated with porphyrins: Geochim. et Cosmochim. Acta, v. 33, no. 4, p. 532-535, table, 1969.

A number of amino acids including glycine, alanine, serine, glutamic acid, aspartic acid, leucine and isoleucine were found in hydrolysates of porphyrin and chlorin fractions isolated from petroleum and from ancient and modern sediments. If these are interpreted on the basis of the present preliminary data as residues of proteins originally bonded to biogenic chlorin pigments, molecular weights of about 100-2000 are indicated for the fragments.—Authors' abstract

02419 **Hoffer, Jerry M.** Plagioclase mineralogy of the Rock Creek flow, Columbia River basalts [abs.]: Northwest Sci., v. 43, no. 1, p. 36, 1969.

Hogg, John E. *See* Hickman, G. Daniel. 02452

02085 **Hoggan, Roger D.** Paleontology and paleoecology of the Upper Jurassic Curtis Formation in the Uinta Mountains, Daggett County, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 32, 1969.

02086 **Holland, J. L.; Griswold, D. H.; Bridges, B. L.** Silver Lake Flats dam and reservoir site, American Fork-Dry Creek watershed, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 33, 1969.

02488 **Hollister, Victor F.** Porphyry copper prospecting: California Div. Mines and Geology Mineral Inf. Service, v. 22, no. 4, p. 67, 1969.

Ore "disseminated" in and near igneous rock is commonly called porphyry copper; about half of the United States production comes from the intruded host. An outstanding feature is the alteration halo; most important element in hypogene mineralization is sulfur; resulting mineral assemblages weather to iron oxides and clay. In prospecting, various potash minerals are often tied to copper; in some deposits tourmaline is critical. Late clay development may mask potash metasomatism and silicification may occur well away from metallization. Fractures, most significant for vein fillings, are easily overlooked in outcrop and also permit groundwater leaching. Exploration is most successful where all phases of geology are integrated.—GDC

02335 **Holmes, Charles W.** In the Gulf of Mexico geochemical exploration produces exciting results: Ocean Industry, v. 4, no. 6, p. 49-52, illus., 1969.

In 1968 the U.S. Geological Survey launched a geochemical survey of the Gulf of Mexico continental shelf to assess economic potential for minerals other than hydrocarbons, to define distribution of elements as indices of sediment patterns and sediment transport, and to establish a broad geochemical framework for future investigations using the environmental approach to sediment study on the deep sea floor. Preliminary investigations show anomalously high concentrations of zirconium, which also may indicate presence of other minerals such ilmenite, rutile and monazite; titanium and iron were found associated with the zirconium anomalies.

Distribution of elements is related to sediment types and offers clues to sediment source and transport. Geochemical mapping is being conducted from a ship equipped with a complete laboratory.—MCM

02420 **Holmgren, Dennis A.** Geochronology of the Columbia River ("Yakima") Basalt in central Washington [abs.]: Northwest Sci., v. 43, no. 1, p. 36, 1969.

02170 **Holowaychuk, N.; Gersper, P. L.; Wilding, L. P.** Strontium-90 content of soils near Cape Thompson, Alaska: Soil Sci., v. 107, no. 2, p. 137-144, illus., tables, 1969.

The Sr-90 levels of soils in Ogotoruk Creek watershed increased more than 2 1/2 times from the summer of 1961 to the summer of 1964. This was a reflection of large-scale nuclear testing in September 1961. Very poorly drained soils had a higher average Sr-90 accumulation than the better drained soils.—JWH

Honea, Russell M. *See* Frondel, Clifford. 07541

02464 **Hoover, D. B.; Dietrich, J. A.** Seismic activity during the 1968 test pumping at the Rocky Mountain Arsenal disposal well: U.S. Geol. Survey Circ. 613, 35 p., illus., tables, 1969.

During 1968 pumping tests at the Rocky Mtn. Arsenal disposal well, the U.S. Geological Survey monitored earthquakes and made chemical analyses of fluids removed. Criteria based on frequency, magnitude, and location of local earthquakes were established to suspend pumping if anomalous earthquake activity occurred. During pumping periods earthquake activity remained within acceptable limits; after each of the two major periods an increase in frequency of small earthquakes occurred. Most 1968 earthquakes occurred northwest of the arsenal; however, in the 2 1/2 month period after start of the test, a larger percent occurred on the arsenal than in the previous 8-month period. Temperature in the cooled zone at the well bottom was 12° F warmer two weeks after pumping stopped than it was in January 1968. Preliminary chemical analyses indicate little mixing between waste fluids and connate water.—*from* Authors' abstract

Hopkins, R. H. *See* Mazelsky, R. 07581

Hornback, V. Q. *See* Wahlstrom, Ernest E. 07508

Hose, R. K. *See* Blake, M. C., Jr. 02043

02087 **Hose, Richard K.; Blake, M. C., Jr.** Structural development of the eastern Great Basin during the Mesozoic [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 34, 1969.

Hostetler, P. B. *See* Christ, C. L. 02195

House, R. *See* McAtee, J. L., Jr. 07528

02135 **Howard, James D.** The influence of channel deposits on Upper Cretaceous sedimentation and their effect on coal mining [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 34-35, 1969.

07633 **Howe, George M.; Reed, Lawrence J.; Ball, John T.; Fisher, George E.; Lassow, Gordon B.** Classification of world desert areas: Natick, Mass., U.S. Army Natick Labs., 104 p., illus., 1968.

Climatic conditions and terrain features of arid and semiarid areas throughout the world are summarized, with particular reference to classification criteria. Special attention is paid to features of significance to military operations. Maps of the various areas accompany the report.—MS

Hower, John. *See* Mowatt, Thomas C. 02060

Hoyt, J. H. *See* Hails, J. R. 02361

Hsu, I-Chi. *See* Scharon, LeRoy. 02548

02265 **Hsü, K. Jinghwa.** Role of cohesive strength in the mechanics of overthrust faulting and of landsliding—Reply [to discussion by M. K. Hubbert and W. W. Rubey of 1969 paper]: Geol. Soc. America Bull., v. 80, no. 6, p. 955-960, 1969.

Hsu in reply to Hubbert and Rubey (ibid., p. 953-954) reaffirms his initial contention (ibid., p. 927-952) that the term τ_o cannot be neglected, and amplifies his original arguments, and discusses the points made by Hubbert and Rubey in detail. He prefers to use the term 'initial shearing resistance' to designate τ_a, rather than 'adhesive strength'.—VSN

02301 **Hsü, K. Jinghwa.** Role of cohesive strength in the mechanics of overthrust faulting and of landsliding: Geol. Soc. America Bull., v. 80, no. 6, p. 927-952, illus., tables, 1969.

Hubbert and Rubey assumed that the cohesive strength (τ_o) term of the Mohr-Coulomb criterion for failure could be eliminated once a fracture is started, through the concentration of stress of the propagating edge, and that the thrusting mechanism is governed by the law of frictional sliding of blocks. However, computations show that τ_o is not numerically negligible unless the block slid along an already existing fracture plane. The omission of τ_o from computations could lead to erroneous and misleading results. The Glarus overthrust, which has a ductilely deformed limestone layer in fault zone, is an example of slow thrusting of cohesively bound blocks. The Heart Mountain thrust, which lacks a weak layer in the fault zone and has a shattered upper plate, is an example of rapid thrusting of cohesionless blocks.—RAL

02264 **Hubbert, M. King; Rubey, William W.** Role of cohesive strength in the mechanics of overthrust faulting and of landsliding—Discussion [of paper by K. J. Hsü, 1969]: Geol. Soc. America Bull., v. 80, no. 6, p. 953-954, 1969.

Hubbert and Rubey indicate (see Hsü, ibid., p. 927-952) that initial shear strength, τ^o, would be involved during the fracturing process only over a negligible fraction of the fault surface and after fracture not at all, the assumption that rocks under stress in large overthrusts still obey the laboratory law of frictional sliding is untenable, retention of the case for which shear strength remains undiminished as a result of fracturing is of questionable validity, common absence of thrust motion at catastrophic rates has been considered evidence of retention of cohesion during overthrusting, and the symbol τ_o should be retained to signify cohesive strength and 'adhesive strength' (τ_a) should be used for shear strength along previously formed fractures across which normal stress is zero.—VSN

02365 **Hughes, G. M.; Landon, R. A.; Farvolden, R. N.** Hydrogeologic data from four landfills in northeastern Illinois: Illinois Geol. Survey Environmental Geology Note 26, 42 p., illus., tables, 1969.

Methods of drilling, sampling, and analysis used in investigation of four landfills (Winnetka, Elgin, Woodstock, and DuPage Counties) in northeastern Illinois and geologic and geochemical data are presented for an investigation to determine hydrogeologic conditions and effects of waste disposal at four sites in representative glaciated terrains. Data include piezometer and sampling points, sample description logs, sieve analyses of representative materials, clay mineral analyses, chemical analyses of leachate and ground water associated with the landfills, and results of neutron activation analyses for selected elements. Geologic conditions at the four sites are summarized.—MCM

02543 **Hunt, Charles B.** Geologic history of the Colorado River, *in* The Colorado River region and John Wesley Powell: U.S. Geol. Survey Prof. Paper 669-C, p. 59-130, illus., tables, 1969.

The geologic history of each stretch of the Colorado River and its principal tributaries from their headwaters to the Gulf of California is reviewed. Neither antecedence nor superposition alone seems adequate to account for the anomalous canyons across the many structural barriers, but a combination of the processes (anteposi-

tion) resolves most seeming conflicts in the evidence. This concept of duality assumes a river course superimposed across a barrier and its canyon subsequently deepened by antecedence because of later uplift of the barrier. Stratigraphic evidence at several uplifts indicates this history; the Grand Canyon was eroded before middle Miocene time. The ancestral drainage probably discharged westward at Peach Springs; it had reached the delta before the end of Miocene time.—CBH

02344 **Hurley, Patrick M.; Rand, John R.** Pre-drift continental nuclei: Science, v. 164, no. 3885, p. 1229-1242, illus., tables, 1969.

When almost all available radiometric age data are plotted on maps of the continents, and a reconstruction representing the assemblage of land areas just prior to the last drift episode (at about 200 m.y. ago) is used, the distribution of age provinces in the range 800-1,700 m.y. and >1,700 m.y. shows a grouping within two restricted regions. It is suggested that the growth pattern of the continents has been largely peripheral and concentric about these ancient nuclei in their predrift position. At least some of the accretion process was similar to that observed today when sea floor moves under the edge of a continent. The acceleration of the rate of generation of continental crust is calculated, on the basis of partition of Rb in the crust relative to Sr, as 20 sq km per m.y. per m.y., or 600 cu km per m.y. per m.y., if upper and lower crust are parts of the differentiating crustal system.—DBV

Huxel, C. J. *See* Yamanaga, George. 02539

02194 **Iijima, Azuma; Harada, Kazuo.** Authigenic zeolites in zeolitic palagonite tuffs on Oahu, Hawaii: Am. Mineralogist, v. 54, nos. 1-2, p. 182-197, illus., tables, 1969.

Authigenic zeolites including phillipsite, gismondine, chabazite, gonnardite, natrolite, analcime and faujasite are the principal minerals in the cement of palagonitized alkali basalt and melilite nephelinite tuffs of the Honolulu Series on Oahu, Hawaii. The results of DTA, X-ray, chemical and electron microprobe analyses are given here. The authigenic zeolites are chemically similar to zeolites commonly found in the cavities of mafic lava flows. There is a regular succession of the zeolite formation: K zeolite→Ca×Na zeolites→Na zeolites. This is explained by gradual change in composition of percolating groundwater through the tuff deposits during palagonitization. A sodium contribution by wind-blown salt from seawater and rainfall on the oceanic island probably causes the latter occurrence of Na zeolites in even the uppermost zeolitic tuffs in the semi-arid coastal area.—Authors' abstract

02538 **Isacks, Bryan; Oliver, Jack; Sykes, Lynn R.** Reply [to comments by C. F. Richter on "Seismology and the new global tectonics" (1968)]: Jour. Geophys. Research, v. 74, no. 10, p. 2789-2790, 1969.

Richter's comments (ibid., p. 2786-2788) augment and complement various parts of the paper in question (ibid., v. 73, no. 18, p. 5855-5899, 1968); he notes no difficulties that might invalidate the basic hypothesis that continental drift, sea-floor spreading, transform faults, and mobile plates of lithosphere are in general concordant with the observational facts of seismology. The principal purpose of this reply is to clarify the stand taken by Isacks, Oliver, and Sykes on certain points that have arisen—DBV

02051 **Isherwood, William F.** Regional gravity survey of parts of Millard, Juab, and Sevier Counties, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 35, 1969.

07516 **Ito, Jun; Johnson, Harold.** Synthesis and study of yttrialite: Am. Mineralogist, v. 53, nos. 11-12, p. 1940-1952, illus., tables, 1968.

Rare earth pyrosilicates, $R_2Si_2O_7$ (R = Sc, In, Lu, Yb, Tm, Er, Ho, Y, Dy, Gd) were synthesized in air at 900° to 1600°C. A solid-solution series exists between the Sc and Y analogs at 1300°C in air and 700°C at 2.5 kbar. From experimental results, "high yttrialite" was identified as alpha-(Y, rare earth)$_2$-Si_2O_7 and "low yttrialite" as a

complex silicate of approximate formula $R(Y, \text{rare earth})_3Si_6O_{21}$ where R includes ions of element such as H, Na, Fe, Mg, Mn, Al, Th, and Zr.—*from* Authors' abstract

07573 **Ito, Jun.** Synthetic indium silicate and indium hydrogarnet: Am. Mineralogist, v. 53, nos. 9-10, p. 1663-1673, illus., table, 1968.

The following indium silicates were synthesized hydrothermally and in air: indium grossular, $Ca_3In_2Si_3O_{12}$; indium aegirine, $NaInSi_2O_6$; indium beryl, $Be_3In_2Si_6O_{18}$; indium thortveitite, $In_2Si_2O_7$; indium melanotekite, $Pb_2In_{20}Si_2O_9$; and strontium indium hydrogarnet, $Sr_3In_2(OH)_{12}$. Complete solid solubility was found between ferric iron and indium silicates and hydrogarnet end members. Single crystals of indium aegirine up to 2 cm in length were grown in a Na_2WO_4 flux by slow cooling. The crystal chemical and geochemical behavior of trivalent indium is similar to that of scandium. The ionic radius of trivalent indium of 0.81 A given by Pauling is confirmed.—Author's abstract

Iverson, R. M. *See* Cook, Kenneth L. 02113

07538 **Izett, G. A.; Wilcox, R. E.** Perrierite, chevkinite, and allanite in upper Cenozoic ash beds in the western United States: Am. Mineralogist, v. 53, nos. 9-10, p. 1558-1567, illus., tables, 1968.

Small primary crystals of perrierite, chevkinite and allanite occur in Cenozoic airfall ash beds at several localities in the western United States. The nonmetamict crystallinity of all three minerals gave definitive X-ray and optical data on unheated material.—Authors' abstract

Jackson, Frederick C. *See* Greenwood, J. Arthur. 02453

Jackson, M. L. *See* Chapman, S. L. 02299

Jaeger, R. R. *See* Lipschutz, M. R. 02540

02199 **Jahanbagloo, I. Cyrus.** X-ray diffraction study of olivine solid solution series: Am. Mineralogist, v. 54, nos. 1-2, p. 246-250, illus., tables, 1969.

Lattice constants of sixteen analyzed olivines fit a linear relation against mole percent forsterite within about 5 mole percent forsterite. Using calculated lattice constants and atomic coordinates estimated from Gibbs' structures of two olivines, spacings and intensities of powder patterns were synthesized for the whole solid solution series.—Author's abstract

07507 **James, Laurence B.** Failure of Baldwin Hills reservoir, Los Angeles, California: Geol. Soc. America Eng. Geology Case Histories, no. 6, p. 1-11, illus., 1968.

The reservoir was hollowed out from the head of a ravine, and closed by a rolled earth dam 155 feet high and with five embankments placed at low points along the perimeter. Interbedded marine sand and silt of Pliocene and Pleistocene age made up the foundation. Leveling since 1917 has shown subsidence in the Baldwin Hills area, with up to nine feet by 1962. Tectonism and petroleum withdrawal nearby caused horizontal cracks up to 2500 feet long. Failure of the reservoir on December 14, 1963, is attributed to another earthcrack in the reservoir itself which opened along a known minor fault. The crack opened the floor and abutment of the reservoir and the escaping water enlarged the openings, and in the final stages, the reservoir emptied through a spectacular breach in the main dam.—HRC

02446 **Jarosewich, Eugene; Mason, Brian.** Chemical analyses with notes on one mesosiderite and seven chondrites: Geochim. et Cosmochim. Acta, v. 33, no. 3, p. 411-416, table, 1969.

Chemical analyses, with short notes on mineralogy and chemical procedures, are given for the bronzite chondrites Allegan and Guarena; the hypersthene chondrites Rupota, Cherokee Springs and Saint Severin; the carbonaceous chondrite Efremovka; the enstatite chondrite Pillistfer; and the mesosiderite Patwar.—Authors' abstract

Jasmin, P. H. *See* Bailey, R. L. 02122

Jeffery, H. G. *See* Feder, G. L. 02340

02309 **Jensen, L. S.** Melba Township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 519, scale 1 in. to 1/4 mi., text, 1969.

02310 **Jensen, L. S.** Bisley Township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 520, scale 1 in. to 1/4 mi., text, 1969.

07665 **Jewett, John Mark; Bayne, Charles K.; Goebel, Edwin D.; O'Connor, Howard G.; Swineford, Ada; Zeller, Doris E.** The stratigraphic succession in Kansas: Kansas Geol. Survey Bull. 189, 81 p., illus., tables, 1968.

Deposits of all the systems in the geologic column above the Precambrian, excepting the Triassic, are found in Kansas. Cambrian, Ordovician, Silurian, Devonian, and most of the Mississippian rocks are present only in the subsurface. The older outcropping rocks (Mississippian-Permian) occur principally in the eastern partof the State, the younger (Jurassic-Tertiary) in the western two-thirds of the State. Deposits of Pleistocene age are statewide in occurrence. The classification and nomenclature of the geologic units is that adopted by the State Geological Survey of Kansas for its official use in accordance with the principles set forth in the 1961 *Code of Stratigraphic Nomenclature* (American Comm. Strat. Nomenclature).—Authors' abstract

07678 **Jewett, John Mark.** The Kansas Academy of Science and one hundred years of the evolution of geology: Kansas Acad. Sci. Trans., v. 71, no. 3, p. 315-326, 1968.

At the birthtime of the Academy, 100 years ago, geology had entered its Golden Age, dominated by men of the stature of early surveyors—Hayden, King, Powell and Wheeler. The *de facto* founders of the Kansas Academy of Science, known until 1871 as the Kansas Natural History Society, were Professors J. D. Parker and D. F. Mudge. An account of the development of geology in general includes a survey of geological scholarship, especially in Kansas. Also mentioned are important paleontological finds in Kansas, and publications of note, not the least of which is the monumental *Treatise of Invertebrate Paleontology*, edited recently by R. C. Moore. The Kansas Geological Survey has been a close symbiont of the Academy. Glacial geologists not fully appreciated were J. E. Todd and W. H. Schoewe.—GDC

02404 **Jodry, Richard L.** Growth and dolomitization of Silurian reefs, St. Clair, Michigan: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 4, p. 957-981, illus., table, 1969.

Silurian reefs in the St. Clair-Macomb area in southeastern Michigan developed in successive growth stages in relatively shallow water. The reefs now form a pinnacle in relation to surrounding sediments because of their resistance to compaction and the compaction of the surrounding sediments. The reef limestone was dolomitized by the flow of large quantities of connate water escaping from lithifying sediments shortly after deposition. Dolomitization increased porosity and has been preserved because of a strong reef framework which resisted compaction.—*from* Author's conclusions

Johnson, G. R. *See* Anderson, L. A. 02255

Johnson, Gerald G., Jr. *See* Keester, Kenneth L. 02180

Johnson, Harold. *See* Ito, Jun. 07516

Johnson, Henry S., Jr. *See* Colquhoun, D. J. 02356

02369 **Johnson, Quintin; Smith, Gordon S.; Kahara, Eileen.** Automatic determination of crystal structure: Science, v. 164, no. 3884, p. 1163-1164, 1969.

Several crystallographic computer programs have been organized int › one large automatic program for solving crystal structures. The emphasis of this organization has been to produce a noninteractive system, that is, to have all decisions made by the computer. Input data are the raw intensity data, cell constants, space group, chemical

formula, and other miscellaneous items. The output is a stereo picture of the contents in a unit cell. The program, operating in a noninteractive mode, has successfully solved compounds of unknown structure; in addition, for a test compound of completely unknown composition, this program deduced the correct structure with an average error in bond distance of 0.05 A and an average error in bond angle of 7°. —Authors' abstract

02513 **Johnson, Ross B.** Pecos National Monument, New Mexico—Its geologic setting: U.S. Geol. Survey Bull. 1271-E, p. E1-E11, illus., geol. map, 1969.

The ruins of the pueblos and missions preserved at Pecos National Monument are near the junction of Glorieta Creek and Pecos River at the south end of the Sangre de Cristo Mountains in northern New Mexico. A few miles to the south the steep escarpment of Glorieta Mesa at Cerro de Escobas rises 1,270 feet above the ruins. Here, the rocks of Permian and Triassic age lie in nearly horizontal layers that can be grouped readily into six units of similar strata, easily recognized from the monument. These rocks, well exposed throughout the region, are largely responsible for the landscape and scenery in the vicinity of Pecos and also supplied the construction material for the pueblos and missions.—RBJ

07661 **Johnston, F. J.** Molybdenum deposits of Ontario: Ontario Dept. Mines Mineral Resources Circ. 7, 98 p., illus., tables, 1968.

This mineral inventory describes briefly or lists 308 molybdenum occurrences in Ontario. There has been only sporadic production from any of the properties and this was mainly during the First World War from hand-cobbing operations in the eastern area. [There are no mines producing molybdenum either as a by-product or as the principal metallic constituent.]—Author's abstract

Joiner, Thomas J. *See* Moore, Donald B. 07695

02052 **Jones, Alan M.** Radiographic analysis of the internal structure of fine grained clastic rocks [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 37, 1969.

02053 **Jones, Daniel J.** Teaching the evolutionary continuum [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 38, 1969.

02181 **Jones, Norris W.** Crystallographic nomenclature and twinning in the humite minerals: Am. Mineralogist, v. 54, nos 1-2, p. 309-313, illus., table, 1969.

The several crystallographic settings previously used for the humite minerals have led to mistakes and confusion in space group, cleavage and twinning descriptions. The Taylor and West setting is preferred because it allows ready comparison of humites and structurally analogous olivines. Twinning on (001) in chondrodite yields single crystal diffraction patterns consistent with orthorhombic rather than monoclinic symmetry.—Author's abstract

Jones, Robert L. *See* Ahmad, N. 02171

Jorgensen, P. J. *See* Westbrook, J. H. 07535

02136 **Juras, Dwight S.; Siems, Peter L.** Use of the citrate-extractable total heavy metals test in prospecting for silver veins, Coeur d'Alene district, Idaho [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 38, 1969.

Kahan, Alfred. *See* Lipson, Herbert G. 07580

Kahara, Eileen. *See* Johnson, Quintin. 02369

07569 **Kamb, Barclay.** Structural basis of the olivine-spinel stability relation: Am. Mineralogist, v. 53, nos. 9-10, p. 1439-1455, illus., tables, 1968.

Crystal chemical reasons are given for the relative stabilities of the olivine and spinel forms of $(Mg,Fe)_2SiO_4$ at low and high pressures. The explanation lies in Pauling's rules for edge sharing by coordination polyhedra in ionic crystal.—MR

07647 **Kantrowitz, I. H.** Ground-water resources in the vicinity of the Crown Point Fish Hatchery, Essex County, New York: New York Water Resources Comm. Rept. Inv. RI-2 13 p., illus., tables, 1968.

The only permeable geologic materials close enough (1,500 feet) to the Crown Point Fish Hatchery that may be regarded as a potential source of additional ground-water supply are the ice-contact deposits (well sorted sand with some gravelly zones) in Putnam Creek valley. Rate of recharge to the aquifer from precipitation ranges from 100-170 gpm; however, perennial yield depends upon extent of the aquifer and amount of recharge available by seepage from Putnam Creek. Probable yields range from 50-100 gpm from precipitation recharge and 100-200 gpm from recharge from precipitation and natural-stream infiltration. All computed well-yield data are based upon the assumption that wells would be pumped continuously; higher rates would be possible if pumping were intermittent.—*from* Author's conclusions

Katz, Eli Joel. *See* McDonald, Martin F. 02507

Katz, Samuel. *See* Shock, Robert N. 07533

02504 **Kaula, William M.** Comment on paper by P. Goldreich and A. Toomre, "Some remarks on polar wandering" [1969]: Jour. Geophys. Research, v. 74, no. 10, p. 2568-2569, 1969.

Goldreich and Toomre [ibid., p. 2555-2567] propose an excellent and plausible hypothesis to explain the present departure of the Earth's oblateness from hydrostatic equilibrium. Their statistical discussion is not clear, however, and in effect they accuse MacDonald (1965), McKenzie (1966), and Kaula (1967) of having said something they did not actually say concerning the spherical harmonic coefficient C_{20}'. It is shown here that what they actually said and what Goldreich and Toomre thought they said are nevertheless both true statements.—DBV

02560 **Kaushal, Sushil K.; Wetherill, G. W.** Rb^{87}-Sr^{87} age of bronzite (H group) chondrites: Jour. Geophys. Research, v. 74, no. 10, p. 2717-2726, illus., tables, 1969.

Thirteen olivine bronzite (H group) chondrite falls and two bronzite finds have been analyzed for K, Rb, and Sr elemental concentrations and Sr isotopic composition. The mean of the most extreme isochrons drawn from the bronzite chondrite data defines an age of 4.69 ± 0.14 b.y. The bronzite finds do not fall on the isochron. The K/Rb ratio varies from 87 for Beardsley to 448 for Beaver Creek. The bronzite chondrite age is possibly higher than the recently measured age for hypersthene (L group) chondrites but is in excellent agreement with the measured Rb-Sr ages of amphoterite (LL group) chondrites, achondrites, and iron meteorites.—*from* Authors' abstract

Kawamura, J. *See* Lipson, Herbert G. 07580

07625 **Keen, M. J.** An introduction to marine geology: London and Toronto, Pergamon Press, 218 p., illus., tables, 1968.

This textbook discusses some elements of marine geology and geophysics for the elementary student of geology and for scientists who are not specialists in these fields but may be associated with those who are in the laboratory or on board ship. An introductory chapter gives an elementary account of some geologic phenomena such as the gross structure of the Earth, rocks of the outer crust, rock-forming minerals, and igneous rocks and their classification. The eight other chapters are: geophysical techniques for exploration of the sea floor, topography of the ocean floor, pelagic sediments, abyssal plain sediments, movements of the sea floor, igneous rocks of ocean basins, structureof ocean basins, and polar wandering and continental drift. Appendixes give the geologic time scale as of 1964 and list rock-forming silicates.—VSN

02297 **Keeney, D. R.; Bremner, J. M.** Determination of soil cation exchange capacity by a simple semimicro technique: Soil Sci., v. 107, no. 5, p. 334-336, table, 1969.

A CEC method is described which does not involve removal of the excess saturating cation by exhausting washing. The soil sample is treated with 1N NH_4OAc, the NH_4OAc removed by leaching with NH_4NO_3 solution, and the treated sample analyzed directly for NH_4-N by steam distillation with 2M NaCl and MgO after partial removal of NH_4NO_3 by washing with a small amount of isopropanol. The method is simple, precise, and gives results similar to the accepted CEC method.—JWH

02180 **Keester, Kenneth L.; Johnson, Gerald G., Jr.; Vand, Vladimir.** New data on tychite: Am. Mineralogist, v. 54, nos. 1-2, p. 302-305, table, 1969.

X-ray diffraction powder data for tychite from Searles Lake, California: strongest lines are [511], 2.67$_4$ A, (100); [311], 4.18 A, (76); [440], 2.459 A (40); Least-squares gave $a = 13.898 \pm 0.001$ A; X-ray density 2.586 g/cm^3 at 24°C. Refractive index $n_D = 1.510$ at 25.8°C.—Authors' abstract

Keil, Klaus. *See* Snetsinger, Kenneth G. 07552

Keith, John R. *See* Vine, James D. 02512

07537 **Keith, Terry E. C.; Muffler, L. J. Patrick; Cremer, Marcelyn.** Hydrothermal epidote formed in the Salton Sea geothermal system, California: Am. Mineralogist, v. 53, nos. 9-10, p. 1635-1644, illus., tables, 1968.

Epidote is being formed as a hydrothermal metamorphic product in metasediments in the Salton Sea geothermal system. One of the two analyzed epidotes has a composition of 32 mole percent $Ca_2Fe_3Si_3O_{12}(OH)$ and occurs with chlorite, hematite, pyrite, quartz, albite, and K-feldspar. The second epidote has a composition of 20 mole percent $Ca_2Fe_3Si_3O_{12}(OH)$ and occurs with iron-bearing tremolite, quartz, and pyrite. Both epidotes formed at temperatures of approximately 320°C and under 125-145 atm hydrostatic pressure. Variation in oxygen fugacity is the mechanism most likely to account for the different epidote compositions and mineral associations.—Authors' abstract

Keller, G. V. *See* Wuenschel, P. O. 02499

02080 **Kelley, Vincent C.** Westward overturning near the Absaroka thrust, Uinta County, Wyoming [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 38-39, 1969.

02524 **Kellogg, William C.** Trends in mining geophysics: Mining Eng., v. 21, no. 2, p. 77, 1969.

During 1967-68 there was continued use of proved mining geophysical methods, as well as experimentation with new but unproved methods. New developments include the digitization and computerization of geophysical data, and the use of applications of gamma-ray spectrometry, of detailed measurements of the vertical gradient in the Earth's total magnetic field, of VLF signals to detect buried conductors, and of remote-sensing techniques. A list of suggestions for future technological developments is given.—MAC

Kempton, John P. *See* Frye, John C. 02302

02081 **Kennecott Copper Corporation.** Geology and ore deposits of the Tintic mining districts [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 39, 1969.

02082 **Kernaghan, James Stewart.** Development of Precambrian metamorphic rocks in the Harney Peak area, Black Hills, South Dakota [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 40, 1969.

Kerr, Paul F. *See* Gavasci, Anna T. 07634

07521 **Kesler, Stephen E.; Weiblen, Paul W.** Distribution of elements in a spherulitic andesite: Am. Mineralogist, v. 53, nos. 11-12, p. 2025-2035, illus., table, 1968.

Electron microprobe and bulk chemical analyses [of andesite, Colombier volcanics, Haiti] indicate (1) that potassium is concentrated and sodium and magnesium are depleted in spherulites; (2) calcium, silicon, and titanium are concentrated, and aluminum and potassium are depleted in a 10-00μ-wide band of brittle mica(?) which is peripheral to the spherulites. Both the groundmass and spherulite plagioclase have a composition of approximately An_{40} and have potassium-rich rims. This distribution of elements conforms to that predicted from observations of spherulite formation in polymer melts. The growth rate of the spherulites was approximately 10^{-6} cm per sec.—*from* Authors' abstract

Khattab, Mohamed M. M. *See* Cook, Kenneth L. 02115

Khoury, S. G. *See* Skinner, William R. 02266

Kiessling, Edmund W. *See* Koenig, James B. 07666

Kimel, W. R. *See* Eckhoff, N. D. 07676

02437 **King, Philip B.** The tectonics of North America—A discussion to accompany the Tectonic Map of North America, scale 1:5,000,000: U.S. Geol. Survey Prof. Paper 628, 95 p., illus., tables, 1969.

The "Tectonic Map of North America," on a scale of 1:5,000,000, has been compiled by the United States Geological Survey in collaboration with other national geological surveys and various individuals. North America is divided tectonically into foldbelts of different ages and platform areas where flat-lying or gently tilted rocks lie upon basements of earlier foldbelts. The two most extensive platform areas are those with Precambrian basement in the central craton, and those with Paleozoic basement in the Atlantic and Gulf Coastal Plains. The foldbelts include three of Precambrian age with principal exposures in the Canadian Shield, four mainly of Paleozoic age, two mainly of Mesozoic age, and two mainly of Cenozoic age. Each was formed during a geotectonic cycle many geologic periods in length, beginning with a geosynclinal phase, passing through a time of orogeny, and ending with a postorogenic phase.—PBK

02137 **Kistler, Ronald W.; Willden, Ronald.** Age of thrusting in the Ruby Mountains, Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 40-41, 1969.

Kitano, Y. *See* Kunze, G. W. 07660

02066 **Kiver, Eugene P.** Neoglaciation in the Rawah Peaks, Colorado [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 41, 1969.

02422 **Kiver, Eugene P.** Cameron Mountain landslides, southern Medicine Bow Mountains, Colorado [abs.]: Northwest Sci., v. 43, no. 1, p. 37, 1969.

Klassen, R. W. *See* Yorath, C. J. 02384

02197 **Klein, Cornelis, Jr.** Two-amphibole assemblages in the system actinolite-hornblende-glaucophane: Am. Mineralogist, v. 54, nos. 1-2, p. 212-237, illus., tables, 1969.

Electron-probe analyses and optical descriptions are given for 22 amphibole pairs. In actinolite-hornblende pairs, hornblende has the lower Mg/(Mg + Fe) ratio. In actinolite-glaucophane pairs, glaucophane has lower Mg/(Mg + Fe) as well as lower Si/(Si + Al) ratios. In four out of six hornblende-glaucophane pairs, glaucophane has the smaller Mg/(Mg + Fe) ratio, whereas in two, this is reversed. Four pairs, consisting of glaucophane and hornblende-glaucophane, have Mg/(Mg + Fe) and Si/(Si + Al) fractionation patterns very different from other pairs. The majority of textures show complex zonation and patches of two amphiboles in composite grains. These

assemblages are evidence for miscibility gaps in the system at relatively low temperatures; the majority occur in greenschist or epidote amphibolite, and glaucophane schist facies, all formed at lower temperatures.—*from* Author's abstract

Kleinpell, R. M. *See* Blacut, Gustavo. 02557

Klepper, M. R. *See* Doe, B. R. 07636

Klute, A. *See* Raats, P. A. C. 02177

07578 **Knight, S. H.** Precambrian stromatolites, bioherms and reefs in the lower half of the Nash Formation, Medicine Bow Mountains, Wyoming: Wyoming Univ. Contr. Geology, v. 7, no. 2, p. 73-116, illus., 1968. 02495

Early Proterozoic stromatolitic metadolomite bioherms and reefs occur in the Nash Formation, 6,500 feet thick, which is part of a 25,000-ft sequence of metasediments forming the core of the range. The formation is believed to be not less than 1,700 m.y. old. Some 150 bioherms and three reefs were mapped; the former up to 100 feet thick and 10-100 feet long, the latter, 200 feet thick and several thousand feet long. Structural forms and growth patterns are described in geometric terms. Descriptions are based on field observations and 100 large thin sections. Three types of stromatolites recognized are: digitate, undulate, and micro-oncolite. Structural forms include: single and laterally linked domes; spheroidal, ellipsodal, and oblong shaped heads; and combinations. Changes attributable to metamorphism are discussed.—*from* Author's abstract

Knowles, L. I. *See* Kunze, G. W. 07660

07666 **Koenig, James B.; Kiessling, Edmund W.** Index to geologic maps of California, 1961-1964—A supplement to Special Report 52: California Div. Mines and Geology Spec. Rept. 52B, 72 p., illus., 1968. 02333

02067 **Koons, Donaldson.** Evolution of the Colorado River in Arizona [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 41-42, 1969.

Kopf, R. W. *See* Morris, Hal T. 02059

Kramer, W. E. *See* Mazelsky, R. 07581

02300 **Krishna Murti, G. S. R.; Satyanarayana, K. V. S.** Significance of magnesium and iron in montmorillonite formation from basic igneous rocks: Soil Sci., v. 107, no. 5, p. 381-384, tables, 1969.

The partial correlation and the coefficients of clays from black, reddish-brown, and lateritic soils have shown that octahedral iron is much more effective than octahedral magnesium in the formation of montmorillonite. CEC and the montmorillonite content show a better correlation with Mg/Fe and Fe/Al ratios than with Mg/Al ratios of the clays.—JWH 02338

Kudo, Albert M. *See* Brown, William T., Jr. 02062

Kumbasar, Isik. *See* Finney, J. J. 02469

02068 **Kuntz, Mel A.** Crystallization temperatures, f_{oxygen}, and P_{water} of a granodiorite-rhyolite magma series, Buckskin Gulch intrusive complex, Colorado [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 42, 1969.

07660 **Kunze, G. W.; Knowles, L. I.; Kitano, Y.** The distribution and mineralogy of clay minerals in the Taku estuary of southeastern Alaska: Marine Geology, v. 6, no. 6, p. 439-448, illus., table, 1968.

Eighteen of 35 clay samples collected from Taku estuary were fractionated with the supercentrifuge to obtain mineralogic details not available from diffraction patterns

of bulk clay. Halloysite in trace to small amounts in the <0.08μ fraction is the only member of the kaolin family detected; kaolinization of feldspars is apparently retarded in a cold environment. Montmorillonite is the dominant component of the <0.08μ fraction, but is found in much smaller quantities in medium and coarse clay fractions; its origin is with trioctahedral micas stripped of interlayer potassium. Most clay minerals in the estuary are primary layer silicates reduced to clay size. Quartz and plagioclase are abundant in silt and sand fractions but are confined to coarse clay of the clay fractions and in trace amounts. Grinding by ice does not reduce significant amounts below 2μ in size.—*from* Authors' abstract

02495 **Kuo, John T.; Ottaviani, Mario; Singh, Shri K.** Variations of vertical gravity gradient in New York City and Alpine, New Jersey: Geophysics, v. 34, no. 2, p. 235-248, illus., tables, 1969.

Gravity measurements with La Costa-Romberg gravimeters were carried out in tall buildings on a floor-to-floor basis in New York City and in Armstrong Tower, Alpine, N.J. After corrections, the observed gravity versus elevation curves are nonlinear, particularly near the surface of the ground. The slope of the observed gravity anomaly versus elevation curves reverses sign at an elevation of about 170 feet for Columbia University buildings and about 350 feet for downtown buildings, and is nearly linear without a reversal for the Armstrong Tower. The vertical gradients vary substantially even within short distances. Comparisons are made of the corrected observed gradients with theoretical gravity gradients. The anomalous gradient anomalies are positive and are correlated with the positive isostatic surface gravity anomalies.—*from* Authors' abstract

Kuroda, P. K. *See* Reynolds, M. A. 02559

02333 **Lagaay, R. A.** Geophysical investigations of the Netherlands Leeward Antilles: Koninkl. Nederlandse Akad. Wetensch. Verh., Afd. Natuurk., ser. 1, v. 25, no. 2, 86 p., illus., tables, 1969.

Results of gravity and magnetic surveys on the islands of Aruba, Curaçao, and Bonaire during the summer of 1962 and in the surrounding sea in 1964-65 are reported and interpreted. There is a broad zone of negative isostatic anomalies north of Curaçao and a positive anomaly over Curaçao, which can be explained by wave-like deformation of the crust in the transitional region between ocean and continent. The Leeward Antilles area is a continental margin area that has been deformed by movement of the South American continent, considerable piles of sediment being deposited in the resulting crustal downwarps. The Lesser Antilles area is a region where oceanic crust is carried downward, accompanied by considerable volcanic and seismic activity and formation of crustal upwarps and downwarps. Both structures are governed by the process of continental drift and sea-floor spreading.—DBV

Lahren, L. H. *See* Bailey, R. L. 02122

Lakshmanan, C. *See* McLean, E. O. 02172

02338 **Landis, Edwin R.; Dane, Carle H.** The Tierra Amarilla coal field, Rio Arriba County, New Mexico: New Mexico Bur. Mines and Mineral Resources Circ. 100, 14 p., illus., tables, geol. map, 1969.

The Tierra Amarilla coal field comprises a small block of coal-bearing rocks of the Mesaverde Group on the east flank of the Chama basin 12 miles east of the nearest Mesaverde outcrops on the San Juan Basin's northeast flank. At the west end as many as nine coal beds are present but most are thin and all are lenticular; beds near the base of the coal-bearing sequence are thicker, locally to 49 inches, and more persistent. The subbituminous A rank coal has been mined for local domestic use at several places in the western part. A progressive eastward change in lithology reduces carbonaceous and clayey material in the Mesaverde to a very small amount and greatly increases the sandstone in the unit. The Mesaverde also seems to thin to the east and northeast—the seaward direction at the time of deposition of the Upper Cretaceous rocks.—*from* Authors' abstract

Landon, R. A. *See* Hughes, G. M. 02365

07687 **Landwehr, W. R.** The genesis and distribution of major mineralization in western United States: Econ. Geology, v. 63, no. 8, p. 967-970, 1968.

Laramide plutons associated with ore districts are similar in composition and mode of emplacement to those unrelated to ore deposits, so the difference must lie in the ultimate source of the magma. Plutons of productive centers are confined to northeast-trending mineral belts and are related to tensional fractures that allowed ascent of parent basaltic magma. Barren plutons are widely scattered and are believed to have formed by anatexis at deep crustal levels during downfolding.—WSW

02069 **Laney, R. L.** Carbonate cementation of Tertiary and Quaternary nonmarine clastic deposits by ground water, Tucson Basin, Arizona [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 42-43, 1969.

07530 **Langbein, Walter B.; Leopold, Luna B.** River channel bars and dunes—Theory of kinematic waves: U.S. Geol. Survey Prof. Paper 422-L, p. L1-L20, illus., tables, 1968.

A kinematic wave is a grouping of moving objects in zones along a flow path and through which the objects pass. These concentrations may be characterized by a simple relation between the speed of the moving objects and their spacing as a result of interaction between them. Flume studies show that flux-concentration curves similar to previously known cases can be constructed from experimental data. Concentration of particles in wave bed forms results when particles in transport become more numerous or closely spaced and interact to reduce the effectiveness of water to move them. Field observations in which rocks were placed at various spacings on the bed of an ephemeral stream to study the effects of storm flows agree with experimental data. Dunes and gravel bars may be considered kinematic waves caused by particle interaction and certain of their properties can be related to the flux-concentration curve.—*from* Authors' abstract

02070 **Lange, Ian M.; Cheney, Eric S.** Sulfur isotopic geology of Butte, Montana [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 43, table, 1969.

02071 **Langhus, Bruce G.; McGugan, Alan.** Vancouver Island Cretaceous Foraminifera [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 44, 1969.

02380 **Langston, Robert B.; Pask, Joseph A.** The nature of anauxite [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 6, p. 425-436, tables, 1969.

Anauxite crystals are reported to contain a higher silica-alumina ratio than the 2:1 ratio in kaolinite. A proposed structure places the excess silica in double silica sheets, but an exact structure has never been determined. Many workers believe that anauxite is kaolinite associated with very fine-grained excess silica, not a part of the structure. Eight specimens studied were from Czechoslovakia and the Ione Formation, Calif. Weight loss, differential solution rate, kinetic, and X-ray diffraction studies were used to establish the composition of the kaolinite clay fraction in the anauxite specimens. Some of the anauxite grains are aggregates bound together by an amorphous silica phase. Hot caustic leaching extracts the silica, breaking up the aggregates and producing fines. Improved characterization of minor impurities were obtained when residues from this treatment were studied by X-ray diffraction.—*from* Authors' abstract

02351 **Larina, N. I.** Paschet ploshchadey Tikhogo Okeana, ego morey i ryada kotlovii [with English abs.]: Okeanologiya, v. 8, no. 4, p. 646-658, illus., tables, 1968; English translation, Oceanology, v. 8, no. 4, p. 518-529, 1969.

Bathymetric curves of the Pacific Ocean, its seas, and several of its basins [including the Bering Sea] are presented. Curves were obtained by calculating the weighted

areas at relief intervals of 500 m, as shown on the new bathymetric chart of the Pacific compiled at the Institute of Oceanology, USSR Academy of Sciences. Results are tabulated in terms of area and percentage, and tables are then used to calculate average depths and volumes.—*from* Author's English abstract

02386 **Larochelle, A.; Pearce, G. W.** A possible source of error in determining the remanent magnetization of cylindrical rock specimens with a biastatic magnetometer: Canada Geol. Survey Paper 68-62, 13 p., illus., 1969.

An evaluation is made of the systematic error involved in determining the magnetization of a uniformly magnetized cylinder from the field measured along three of its mutually perpendicular axes of symmetry and using the assumption that the specimen's moment may be considered as a small dipole at its center of symmetry. In addition, the optimum height/diameter ratio is established for cylindrical specimens to be examined with a biastatic magnetometer. It is shown that within a group of magnetization directions obtained for cylindrical specimens the component of angular dispersion related to the dipole approximation and to ordinary departures of the specimen's dimensions from their optimum values is negligible compared to that related to the in situ orientation errors which can be reasonably assumed to be of the order of 2 or 3 degrees.—Authors' abstract

02505 **Larochelle, A.** Paleomagnetism of the Monteregian Hills—Further results: Jour. Geophys. Research, v. 74, no. 10, p. 2570-2575, illus., tables, 1969.

Magnetic measurements were made on 112 independently oriented drill cores from 22 sites in 6 mafic intrusive plugs of the Monteregian Hills group in southeastern Quebec. On the basis of magnetization homogeneity criteria, less than 80 percent of the sampled cores were accepted as reliable carriers of paleomagnetic information. Data obtained for 16 sites yielded a mean direction of magnetization at D = 157.4° and I = -59.9°. These data together with 75 previously reported mean directions for 4 other members of the Monteregian Hills group yield a pole position at 170.5° W., 71.3° N. The low angular standard deviation of the 32 "weighted" site means summarizing these data (7.8°) suggests that the nondipole component of the geomagnetic field was less important in Cretaceous times than over the last 10 m.y.—DBV

02341 **Larson, E.; Ozima, Mituko; Ozima, Minoru; Nagata, T.; Strangway, D.** Stability of remanent magnetization of igneous rocks: Royal Astron. Soc. Geophys. Jour., v. 17, no. 3, p. 263-292, illus., table, 1969.

A better estimation of the magnetic stability of a rock could be obtained by measuring the spectrum of coercivities; a simple means of obtaining the coercivity spectrum is presented. It is also shown that a relation between the distribution of grain size and the spectrum of coercivities exists, not only for prepared samples, but for rocks as well. An evaluation of the sizes of the opaque grains effectively controlling the magnetic properties must not only take account of initial crystallization processes but must include consideration of post-consolidation, high- and low-temperature oxidation modifications. The development of effective grain size is discussed. Results of this study have provided additional insight into the relation of the shape of a Js-T curve and the opaque mineralogy.—*from* Authors' abstract

02072 **Larson, Edwin E.; Mutschler, Felix E.** Nature of the East Pacific Rise and its relation to Basin and Range structure [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 44, 1969.

07603 **Larson, Lawrence T.** Mineral resources summary of the Mt. Peter quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 3 p., 1968.

The only mineral resource mined in the Mt. Peter quadrangle is sand from the McNairy Formation; a potential resource is heavy minerals. This text accompanies Tennessee Div. Geology Geol. Map GM 12A-SE by E. E. Russell (cited separately).—MCM

Lassow, Gordon B. *See* Howe, George M. 07633

Latham, Gary V. *See* Anderson, Rockne S. 02562

Lavin, Peter M. *See* Behrendt, John C. 07532

Lavin, S. J. *See* Bailey, R. L. 02122

02568 **Lay, E. P.** Core-sampling techniques: Oceans, v. 1, no. 3, p. 27-29, illus., 1969.

Ocean-floor sediment samples to be of maximum value should be undisturbed. In shallow water they can be obtained by hand-forced or piston samplers, some of which are described. The most common types of deep-sea corers are gravity and piston, and two types of the latter are Kullenberg and Ewing. A 20 m undisturbed core obtained off Puerto Rico is cited as an example of the type of sampling possible. Other types of corers, well-drilling, and grab techniques are described also.—ESL

02303 **Leahy, E. J.** Carman Township, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P. 356 (revised), scale 1 in. to 1/4 mi., text, 1969; originally published 1966.

For abstract, *see* Abstracts of North American Geology for March 1967.

02322 **Leahy, E. J.** Cody Township, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P. 545, scale 1 in. to 1/4 mi., text, 1969.

02323 **Leahy, E. J.** Macklem Township, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P. 546, scale 1 in. to 1/4 mi., text, 1969.

02324 **Leahy, E. J.** Thomas Township, District of Cochrane: Ontario Dept. Mines Prelim. Geol. Map P. 547, scale 1 in. to 1/4 mi., text, 1969.

Leahy, E. J. *See* Bennett, G. 02570

Learned, R. E. *See* McCarthy, J. H., Jr. 02466

02423 **Lefebvre, R. H.** Columbia River Basalts of the Grand Coulee area [abs.]: Northwest Sci., v. 43, no. 1, p. 38-39, 1969.

07677 **Leisman, Gilbert A.** A century of progress in paleobotany in Kansas: Kansas Acad. Sci. Trans., v. 71, no. 3, p. 301-308, illus., 1968.

Rocks of Mississippian to Pleistocene age crop out from east to west in Kansas and have yielded a wealth of paleobotanical material. Museums of the world owe many prize Cretaceous specimens to Charles Sternberg, the first scientific collector although not a trained scientist. Other well known early investigators of the Pennsylvanian, Permian, and Tertiary floras included David White, E. H. Sellards, Maxim K. Elias, and R. E. Moore. Kansas' greatest paleobotanical claim to fame lies in its quantities of Carboniferous coal balls found, especially near West Mineral, in extreme southeastern Kansas; a few of the more important discoveries are summarized. Many early collections and sites, notably the Dakota flora, need reinvestigation. Palynological studies are pitifully few.—GDC

Leith, Carlton J. *See* Welby, Charles W. 02295

02544 **Leopold, Luna B.** The rapids and the pools—Grand Canyon, *in* The Colorado River region and John Wesley Powell: U.S. Geol. Survey Prof. Paper 669-D, p. 131-145, illus., 1969.

Through the Grand Canyon the Colorado drops in elevation about 2,200 feet in 280 miles, mostly in rapids that account for 10 percent of the distance. There are no waterfalls. The bed profile is highly irregular, but the apparent randomness masks an organized alternation of deeps and shallows. Measurement of the age of lava flow that once blocked the canyon near Toroweap shows that no appreciable deepening of the canyon has taken place in the last million years. The river has had the time and the ability to eliminate the rapids. The long-continued existence and relative

straightness of the longitudinal profile indicate that the river maintains a state of quasi-equilibrium which provides the hydraulic requirements for carrying the debris load brought in from upstream without continued erosion of the canyon bed.—*from* Author's abstract

Leopold, Luna B. *See* Langbein, Walter B. 07530

02073 **LeRoy, L. W.** Precambrian stratigraphy northwest of Golden, Jefferson County, Colorado [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 44-45, 1969.

Lewis, D. *See* Northwood, D. O. 07525

02363 **Lidz, Louis; Charm, Walter B.; Ball, Mahlon M.; Valdes, Sylvia.** Marine basins off the coast of Venezuela: Bull. Marine Sci., v. 19, no. 1, p. 1-17, illus., table, 1969.

The Cariaco, Bonaire, and Los Roques basins are located off the northern coast of Venezuela within a physiographic setting similar to the continental borderland off southern California. Pleistocene sediments from the basins consist of finely banded anaerobic silts and clays overlying homogeneous aerobic clays alternating with turbidites and foraminiferal oozes. Landward slopes of the basins contain considerable quantities of terrigenous material, whereas slopes off the sides of offshore islands contain foraminiferal sands and reef debris. The borderland resulted from tectonic processes initiated probably as early as Cretaceous time and culminated towards the close of the Tertiary; its structure and that off southern California indicate faulting is a major factor.—*from* Authors' abstract

07669 **Lill, Gordon G.** Some recent advances in marine engineering: Kansas Acad. Sci. Trans., v. 71, no. 4, p. 385-401, illus., 1968.

Technological developments in platforms for marine exploration are summarized here. The submersibles illustrated are the Trieste, Alvin, Deep Quest, Deep Sea Rescue Vehicle, Beaver, Aluminaut, and Sea Lab-II, also several drilling platforms and the bottle-shaped FLIP. For interdisciplinary sea-bottom investigations, the most exciting is the ocean-floor habitat for aquanaut teams. Offshore petroleum exploration demonstrates the possibilities of other vessels than ships. Most notable in design is that for a Mohole platform 10 stories high.—GDC

Lin, K. *See* Pirie, E. 07563

02074 **Lindsey, David A.** Source of conglomerate in the Harebell and Pinyon Formations of northwest Wyoming [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 45, 1969.

02204 **Lipman, Peter W.; Christiansen, Robert L.; VanAlstine, Ralph E.** Retention of alkalis by calc-alkalic rhyolites during crystallization and hydration: Am. Mineralogist, v. 54, nos. 1-2, p. 286-291, illus., table, 1969.

Normal calc-alkalic rhyolitic lavas that crystallized at the time of emplacement and initial cooling have alkali contents nearly identical to those of comagmatic obsidians (non-hydrated glasses) in four analyzed suites of samples. Except for loss of volatile constituents and oxidation of iron, the crystallized rocks approximate magmatic compositions closely.—Authors' abstract

02540 **Lipschutz, M. R.; Jaeger, R. R.** Shock-induced preferred disorder in solids: Nature, v. 222, no. 5195, p. 766-767, 1969.

A suggestion that at a given pressure, the shock-induced alterations in cohenite and schreibersite would be significantly different was tested by an examination of the Ainsworth meteorite in which both these minerals coexist in a kamacite matrix; α-SiO_2 (quartz) artificially shocked to 350 and 600 kb was studied also. The alteration mechanisms in schreibersite and cohenite apparently are the same, solid-state disordering during the shock wave. The former is much less compressible; a new baromet-

ric scale based on alterations in schreibersite can be established for pressures >400 kb. X-ray detectable preferred disorder was noted also in quartz; if it can be produced only by shock processes, the preferred disorder of quartz may well be diagnostic of any high pressure explosive event.—DBV

07580 **Lipson, Herbert G.; Kahan, Alfred; Adamski, Joseph A.; Farrell, E.; Redman, M. J.; Kawamura, J.** Growth and characterization of variable stoichiometry spinels, *in* Crystal growth 1968—Internat. Conf. Crystal Growth, 2d, Birmingham, U.K., 1968, Proc.: Jour. Crystal Growth, v. 3-4, p. 250-254, illus., 1968.

This paper presents the results of the characterization, by optical spectroscopic, chemical, and X-ray methods, of flame fusion grown magnesium aluminate spinels containing variable amounts of excess alumina and chromium doping. The emphasis of this study is to establish non-destructive physical measurement methods to indicate the quality, internal structural changes, and the stoichiometric composition of the crystals.—Authors' abstract

02438 **Lisitsyn, A. P.** Protsessy sovremennogo osadkoobrazovaniya v Beringovom more: Moscow, Izdatel'stvo Nauka, 574 p., illus., tables, 1966; English translation, Recent sedimentation in the Bering Sea: Springfield, Va., U.S. Clearinghouse Federal Sci. and Tech. Inf., 614 p., illus., tables, 1969.

Following an introductory discussion of the history of exploration of the Bering Sea and its sediments, and the methods used, the following subjects are covered: physiographic features of the sea bottom and its sedimentary influx, and sedimentation conditions in the sea; quantitative distribution of sedimentary material and its qualitative composition; types, mel composition, and mineralogy and petrography of bottom sediments; and regularities governing distribution of major chemical components in sediments and their genesis. Conclusions are drawn as to terrigenous, biogenic, chemogenic, and volcanogenic sedimentation processes.—ESL

02075 **Lofgren, Ben E.** Land subsidence caused by water-level decline in intermontane basins [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 45-46, 1969.

02571 **Loganathan, P.; Swindale, L. D.** The properties and genesis of four middle altitude Dystrandept volcanic ash soils from Mauna Kea, Hawaii: Pacific Sci., v. 23, no. 2, p. 161-171, illus., tables, 1969.

Four soils, originally classified as Latosolic Brown Forest, collected from the north slopes of Mauna Kea, at 3,400 to 6,900 feet, contained volcanic glass and plagioclase, with magnetite, plant opal, and small amounts of olivine and pyroxene. Clay fractions contained allophane. Genetic factors and a summary of properties are tabulated. The driest and least weathered soil is classified as an Entic Dystrandept, two are Typic Dystrandepts, and the wettest and most weathered is a Hydric Dystrandept.—ESL

07549 **Long, William; Friedman, Irving.** The refractive index of experimentally hydrated rhyolite glass: Am. Mineralogist, v. 53, nos. 9-10, p. 1754-1756, illus., 1968.

The relationship between the refractive index and water content was investigated using obsidian samples hydrated at known temperatures and pressures. The shapes of the refractive index versus water content curves for the experimentally hydrated samples depend on the temperature at which the samples were hydrated. The results confirm earlier observations which suggest that natural glasses absorb water at relatively low temperatures.—BAM

02424 **Long, William A.** Neoglacial moraines in the vicinity of Mount Deception [abs.]: Northwest Sci., v. 43, no. 1, p. 39, 1969.

02425 **Long, William A.** A preliminary report on the glaciation of the middle Entiat Mountains, Washington [abs.]: Northwest Sci., v. 43, no. 1, p. 39, 1969.

Loredo-Murphy, Luis. *See* García-Calderón, Jorge. 07648

Love, J. D. *See* Tibbetts, B. L. 02292

02076 **Lovejoy, Earl M. P.** Grand Wash problem at Grand Canyon [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 46, 1969.

02442 **Loveland, W.; Schmitt, R. A.; Fisher, D. E.** Aluminum abundances in stony meteorites: Geochim. et Cosmochim. Acta, v. 33, no. 3, p. 375-385, illus., tables, 1969.

Al abundances have been measured by neutron activation analysis in 120 meteorites and minerals. Average Al abundance values reported are less, in general, than those reported previously and are more accurate. The observed Al standard deviation dispersions in the chemical-petrologic classes of H4-6, L4-6, LL4-6 meteorites are considerably less than earlier values. The average Al/Si atomic ratio of 0.087 is nearly the same for the three classes of carbonaceous chondrites and is distinctly different from a ratio of 0.061 observed in ordinary chondrites. The Al/Na ratio increases progressively from 1.42, 2.40 to 3.29 for the three classes of carbonaceous chondrites C1, 2 and 3. Al/Na ratios are uniform in ordinary chondrites. No significant linear correlation between the Al and Fe abundance of most of the meteorites has been observed.—*from* Authors' abstract

Lovering, T. G. *See* McCarthy, J. H., Jr. 02466

02077 **Lovering, T. S.** The origin of hydrothermal dolomite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 46-47, 1969.

Lowrie, Allen, Jr. *See* Fox, Paul J. 02480

02558 **Lowrie, W.; Fuller, M.** Effect of annealing on coercive force and remanent magnetizations in magnetite: Jour. Geophys. Research, v. 74, no. 10, p. 2698-2710, illus., table, 1969.

When single crystals of magnetite were annealed under controlled conditions, structural changes in the magnetite were followed by changes in magnitudes of coercive force and saturation isothermal remanent magnetization. It seems likely that relaxation of an induced anisotropy by vacancy-assisted cation migration (with activation energy 1-1.5 ev) took place at temperatures well below the Curie temperature. This unstable feature poses a serious problem for certain methods of estimating paleointensity of the geomagnetic field. A further structural change, which appeared to be thermally activated self-diffusion of dislocations (with activation energy around 6 ev), was apparent at temperatures above the Curie temperature. Associated with this change were pronounced changes in a-c demagnetization curves of both isothermal and thermoremanent magnetization. Changes in Curie temperature accompanied both high- and low-temperature effects.—*from* Authors' abstract

02078 **Lucchitta, Ivo.** Early history of the Colorado River in the Basin and Range Province [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 47-48, 1969.

Lumsden, W. W. *See* Moores, E. M. 02058

Lusczynski, N. J. *See* Warren, M. A. 07644

Luth, W. C. *See* Walters, L. J., Jr. 02192

02079 **Luza, Kenneth V.** Bog iron deposits in the Rochford area, Black Hills, South Dakota [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 48, 1969.

02377 **Luzier, J. E.** Ground-water occurrence in the Goldendale area, Klickitat County, Washington: U.S. Geol. Survey Hydrol. Inv. Atlas HA-313, scale 1:62,500, table, text, 1969.

Ground water occurs beneath the Goldendale area chiefly within permeable parts of a gently folded sequence of flows of the Yakima Basalt which is broken by several vertical strike-slip faults crossing the area in a northwesterly direction. Greatest development of ground water has been for domestic and stock use with wells yielding less than 50 gpm; irrigation wells yield from 60-150 gpm. Wells yielding large quantities from basalt aquifers will need to be drilled to considerable depth below the regional water table. Wells generally less than 150 feet deep yield 50-250 gpm from surficial deposits in Swale Valley and from the Ellensburg Formation where it is in hydraulic contact with the Little Klickitat River. Ground water is of good quality for most purposes. The sheet includes drillers' logs, selected well records and partial chemical analyses.—MCM

02406 **MacDonald, Harold C.** Sensing techniques in exploration, Pt. 1: Oil and Gas Jour., v. 67, no. 22, p. 110-112; Pt. 2, ibid., no. 23, p. 116-117, illus., 1969.

Fundamental parameters of remote sensor operation and some of the capabilities and limitations of the sensors are discussed including gamma-ray spectrometers, X-ray sensors, ultraviolet-scanning systems, photography (color, false color, infrared, and multiband), infrared imagery, and radar imagery. Sensor data derived from scanning infrared systems which detect thermal variations between adjacent features and radar imagery which is helpful in the delineation of regional geologic structures appear to have immediate potential for petroleum exploration.—HHA

07694 **MacElvain, Robert C.** Gravity map of Monroe County, Alabama: Alabama Geol. Survey Map 62, scale about 1 in. to 1 mi., text [1968?].

Relatively unconsolidated Jurassic to Pliocene sediments overlie the dense basement complex; their estimated thickness in central Monroe County is 10,000-15,000 feet. Outcropping Eocene to Pliocene formations strike northwest and dip gently southwest. Structure is normal except for small faults in the central section and larger faults to the southwest. Although oil has not been discovered in commercial quantities, production in adjacent counties indicates Monroe is a favorable area for prospecting. Gravity determinations made at stations spaced at intervals of about 1/2 mile along public roads are tabulated. A gravity maximum in the northern section and a large, closed one in the southern half of the county probably indicate buried ridges. A belt of low gravity between the two maxima in the middle section may represent the easternmost extension of the gulf coast salt basin. Several small gravity features merit further investigation.—MCM

02317 **Mackasey, W. O.** Walters Township, District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 539, scale 1 in. to 1/4 mi., text, 1969.

02318 **Mackasey, W. O.** Leduc Township, District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 540, scale 1 in. to 1/4 mi., text, 1969.

MacKenzie, Fred T. *See* Wollast, Roland. 07536

02273 **Mackevett, E. M., Jr.** Three newly named Jurassic formations in the McCarthy C-5 quadrangle, Alaska, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1967: U.S. Geol. Survey Bull. 1274-A, p. A35-A49, illus., 1969.

Mackin, R. L. *See* Bailey, R. L. 02122

02329 **Maclay, R. W.; Bidwell, L. E.; Winter, T. C.** Water resources of the Buffalo River watershed, west-central Minnesota: U.S. Geol. Survey Hydrol. Inv. Atlas HA-307, 3 sheets, scale 1:250,000, text, 1969.

Sheet 1 contains inset maps showing climate and water yield, physical setting, and water use and summary; graphs of runoff; a tabular summary of water resources; and conclusions drawn from the study. Sheet 2 summarizes surface water information of the Buffalo River watershed. Sheet 3 on ground water contains an availability map, information on water quality, a table of community water supplies, and graphs on ground-water development in the Moorhead area. Adequate supplies of ground

water for rural and domestic purposes are available throughout the area; large supplies are known to be generally available only from the mapped aquifers (glacial deposits). Test drilling is necessary to locate sand and gravel lenses in till capable of yielding large quantities. Quality of water is suitable for most purposes.—MCM

MacLeod, Norman S. *See* Snavely, Parke D., Jr. 02429

02138 **Madsen, James H., Jr.** This business of dinosaurs [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 48-49, 1969.

02046 **Magara, Kinji.** Porosity-permeability relationship of shale [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 49, 1969.

02047 **Mahar, James W.; Waltz, J. P.** Estimates of aquifer permeability based on lithologic logs [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 49-50, 1969.

Malamud, M. *See* Gakiel, U. 02179

02381 **Malcolm, R. L.; Nettleton, W. D.; McCracken, R. J.** Pedogenic formation of montmorillonite from a 2:1-2:2 intergrade clay mineral [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 16, no. 6, p. 405-414, illus., tables, 1969.

Montmorillonite was found to be the dominant clay mineral in surface horizons of certain soils of the North Carolina Coastal Plain, whereas the 2:1-2:2 intergrade clay mineral dominated subjacent horizons. In all soils where this sequence was found, the surface horizon was low in pH and high in organic matter. This is in contrast to data from studies of other soils of the region. It is theorized that the montmorillonite originated by pedogenic weathering of the intergrade clay mineral. Combined effects of low pH and high organic matter are believed to be the agents responsible for the transformation. Drainage class or position in a catena is believed to be less important than chemical factors, because montmorillonite is present in all drainage classes if the surface horizon is low in pH and high in organic matter.—*from* Authors' abstract

Mallory, V. Standish. *See* Wheeler, Harry E. 02432

Mann, J. Adin, Jr. *See* Sharma, Munna Lal. 02168

02392 **Manning, P. G.** On the origin of colour and pleochroism of astrophyllite and brown clintonite: Canadian Mineralogist, v. 9, pt. 5, p. 662-677, illus., tables, 1969.

In a spectral study, sections of both minerals cut parallel and perpendicular to the 001 (cleavage) plane were examined in polarized light. Both show a non-pleochroic two-band system in the near-infrared region that is assigned to *d-d* transitions in octahedrally-bonded Fe^{2+}, and exhibit a strong pleochroic absorption band in the blue end of the spectrum that is the obvious cause of color and pleochroism of the minerals. The band is observed as 23,000 cm^{-1} in astrophyllite, and has maximum intensity when *E* coincides with the orientation of Ti-O-Ti units. The band is observed at 22,000 cm^{-1} in clintonite with maximum intensity when *E* coincides with the plane of *d*-orbital overlap between neighbouring cations in the octahedral layer. (*E* represents the vibration direction of the electric vector of incident light). In both minerals, the band is assigned to Ti^{3+}-Ti^{4+} electronic interaction.—*from* Author's abstract

02528 **Manula, C. B.** Operations research and computers in the mineral industry: Mining Eng., v. 21, no. 2, p. 69-73, illus., 1969.

This article reviews pertinent mineral-industry oriented papers and talks published or presented during 1968. Articles emphasizing statistical analysis and computer applications to mineral exploration are among those cited and summarized.—MAC

Marcher, Melvin V. *See* Moore, Gerald K. 07595

Marinenko, John. *See* Hawley, C. C. 02253

02048 **Marsell, Ray E.** Tracing ground-water movements in the Uinta Mountains, Utah, by means of dye tests [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 50, 1969.

Martinez, E. E. *See* Hawley, C. C. 02253

Marvin, R. F. *See* Barker, Fred. 02127

02049 **Marzolf, John E.** Regional stratigraphic variations in primary features of the Navajo Sandstone, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 50-51, 1969.

Mason, Brian. *See* Jarosewich, Eugene. 02446

02050 **Mauger, Richard L.** Relations between mineral deposits and igneous activity in the Park City, Tintic, and Bingham, Utah districts [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 51, 1969.

07581 **Mazelsky, R.; Hopkins, R. H.; Kramer, W. E.** Czochralski-growth of calcium fluorophosphate, *in* Crystal growth 1968—Internat. Conf. Crystal Growth, 2d, Birmingham, U.K., 1968, Proc.: Jour. Crystal Growth, v. 3-4, p. 260-264, illus., 1968.

Large single crystals of fluorapatite grown along major crystallographic axes exhibit morphology consistent with the hexagonal unit cell. The phase diagram was re-examined, and crystals were grown at several off-stoichiometric compositions. Chemical analyses of these indicated fluoride vacancy concentrations as large as 10 percent, consistent with data obtained from lattice parameter and density measurements. Fluorescence characteristics of these undoped crystals are consistent with color center fluorescence associated with fluoride vacancies. Replacement of fluoride with oxygen indicated that anion vacancy concentration in the fluoride site as high as 50 percent could be tolerated. Measurement of physical constants indicates remarkably little anisotropy in the major crystallographic directions.—*from* Authors' abstract

07528 **McAtee, J. L., Jr.; House, R.; Eugster, H. P.** Magadiite from Trinity County, California: Am. Mineralogist, v. 53, nos. 11-12, p. 2061-2069, illus., tables, 1968.

Magadiite occurs in altered volcanic rocks in Trinity County, Calif., with chemical composition equivalent to magadiite from Kenya. X-ray powder diffraction study of both California and Kenys magadiite shows a monoclinic cell with $a = 7.22$, $b = 15.70$, $c = 6.91$, all ± 0.05 A, $\beta = 95°16' \pm 5'$. Kenyaite is also probably monoclinic, $a = 7.79$, $b = 19.72$, $c = 6.91$, all ± 0.05 A, $\beta = 95°54' \pm 5'$. Electron micrography and diffraction confirm that the symmetry is less than tetragonal. DTA analysis gave for both minerals several strong exothermic dehydration peaks between 100° and 200°C, and an exothermic peak near 700°C due to breakdown of the structure.—Authors' abstract

02466 **McCarthy, J. H., Jr.; Learned, R. E.; Botbol, J. M.; Lovering, T. G.; Watterson, J. R.; Turner, R. L.** Gold-bearing jasperoid in the Drum Mountains, Juab and Millard Counties, Utah: U.S. Geol. Survey Circ. 623, 4 p., illus., table, 1969.

Geochemical sampling in the Drum Mountains of Utah has revealed anomalous concentrations of gold in jasperoid outcrops. One jasperoid sample contains 100 ppm gold, and 20 samples from an outcrop about 50 feet wide and 300 feet long average about 10 ppm gold. The gold-bearing jasperoid also contains anomalous amounts of other ore-stage metals and may be useful guides to further exploration.—Authors' abstract

02139 **McCormick, C. D.; Picard, M. Dane.** Petrology of Gartra Member (Triassic), Uinta Mountain area, Utah and Colorado [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 51-52, 1969.

McCracken, R. J. *See* Malcolm, R. L. 02381

02280 **McCutcheon, Thomas E.** Copiah County clay tests, *in* Copiah County geology and mineral resources: Mississippi Geol., Econ. and Topog. Survey Bull. 110, p. 141-172, illus., tables, 1969.

Clays from ten bore holes representing 18 samples were furnished for ceramic testing and evaluation. Ceramic test data, screen and chemical analyses are given with comments. The clays have the basic properties with minor adjustments that make them suitable for the major raw material for a heavy clay products industry.—MCM

02510 **McDonald, John A.; Goforth, Tom T.** Seismic effects of sonic booms—Empirical results: Jour. Geophys. Research, v. 74, no. 10, p. 2637-2647, illus., table, 1969.

Earth particle velocities produced by sonic booms have been recorded at 3 sites in California, Arizona, and Utah. The seismic effects are found to be confined laterally to the area of the boom pressure envelope and vertically to the upper few meters of the Earth's surface. Within a pressure range up to 25 kg per sq m, the maximum ground particle velocity is linearly related to the maximum overpressure of the boom and to the geological properties of the ground; the maximum ground particle velocity measured was about 600 μ per sec. No focusing of seismic energy propagated from inside the hyperbolic intersection of the shock cone with the ground was observed. —DBV

02507 **McDonald, Martin F.; Katz, Eli Joel.** Quantitative method for describing the regional topography of the ocean floor: Jour. Geophys. Research, v. 74, no. 10, p. 2597-2607, illus., table, 1969.

A statistical method for studying the two-dimensional topography of a patch of ocean floor from radial track soundings is discussed and then illustrated for a 18.5-km square located at the intersection of a continental rise and slope. The topographic features highlighted by the study are shown to be related to a detailed bathymetric map of the area with good correspondence. It is, therefore, suggested that a very useful description of an area can be obtained from a minimum number of intersecting tracks, and, since the method is quantitative, it offers the possibility of making objective comparison between different areas. As a result of the particular data used in this study, some observations were made of bending gullies at the base of the continental slope.—Authors' abstract

McDonald, Robert L. *See* Slemmons, David B. 02237

07509 **McGavock, Cecil B., Jr.; Depman, Albert J.** Engineering geology of Spruce Run dam and reservoir, New Jersey: Geol. Soc. America Eng. Geology Case Histories, no. 6, p. 23-32, illus., 1968.

The dam is earth fill with a select impervious core of weathered glacial drift. Random sections are of weathered shale; riprap is limestone from the spillway excavation. The dam is 5400 feet long and 85 feet high above the floodplain. Bedrock is primarily highly faulted, brecciated Kittatinny Limestone bounded by the Hardyston Quartzite and Martinsburg Shale. A grout curtain spans the limestone belt except for two short stretches where the natural water table stands high. The cutoff trench features a concrete grout cap. The upper rock zone beneath much of the fill was blanket-grouted to minimize ground-water movement and sink-hole development.—*from* Authors' abstract

07686 **McGregor, Ronald L.** A C-14 date for the Muscotah marsh: Kansas Acad. Sci. Trans., v. 71, no. 1, p. 85-86, 1968.

South of Muscotah in Atchison County, Kans., is a raised artesian marsh at the edge of the Delaware River flood plain; its maximum height is 7 feet above the surrounding flat terrain. Beneath the mound, consisting of plant material only partly decomposed, is a stratum of 15 feet of decomposed and fragmentary plant materials; then a 5-ft layer of clay, sand, and about 8 percent organic material, followed by a 6-ft layer of fragmentary plants mixed with clay and sand, and at the bottom a 3-ft mixture of clay, sand, and plant material. Through the entire 36 feet, artesian water flows to the surface. From the bottom of a 36-ft core, a large sample of *Abies* needles gave a C-14

date of 15,500 ± 1,500 yr. Although its pollen occurs in all but the upper 10 feet, macro remains are not found above the 20-ft level, which supports evidence for transition from boreal forest to prairie between 11,000 and 7,000 B.P.—GDC

McGugan, Alan. *See* Langhus, Bruce G. 02071

02580 **McHarg, Ian L.** Design with nature: Garden City, N.Y., Natural History Press (for Am. Mus. Nat. History), 198 p., illus., 1969.

This book reviews the destructive role man has played in changing the face of the Earth by defacing the environment and lowering its habitability. Surveying city and countryside, the sea and its shores, highways, the biosphere, water resources, forests and woodlands, land use, space exploration, islands, role of naturalists, river basins, metropolitan areas, relation of form to evolution and to city planning, and health and pathology, the author presents criteria for a model of an inventory of all ecosystems to determine their relative creativity in the biosphere. These inventories could determine locations for land uses and urbanization, but would delineate also the relation of man and organisms to the environment, integrating the sciences, humanities, and the arts, and realizing man's design with nature.—MCM

02307 **McIlwaine, W. H.** Van Hise Township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 517, scale 1 in. to 1/4 mi., text, 1969.

02308 **McIlwaine, W. H.** Haultain Township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 518, scale 1 in. to 1/4 mi., text, 1969.

McKee, E. H. *See* Blake, M. C., Jr. 02043

02542 **McKee, Edwin D.** Stratified rocks of the Grand Canyon, *in* The Colorado River region and John Wesley Powell: U.S. Geol. Survey Prof. Paper 669-B, p. 23-58, illus., 1969.

The record of the Earth's history in the walls of the Grand Canyon has been deciphered through hard work by many people during the past 100 years. Much still remains unsolved. John Wesley Powell's contributions were of a pioneering type, though he was not the first to discuss the rocks of the Grand Canyon. Far more important than his own observations and deductions in the field of stratigraphic geology was his tremendous influence upon the work of his associates and his successors. This chapter traces the evolution of thought concerning the stratified rocks of the Grand Canyon and summarizes present concepts of stratigraphic history as recorded in the walls of the canyon. A brief summary of available data and conclusions on each of the principal sedimentary units is presented.—Author's abstract

02054 **McKee, Edwin H.; Gangloff, Roland A.** Distribution of archacocyathids in the lower Cambrian of southeastern California and southwestern Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 52-53, 1969.

02172 **McLean, E. O.; Lakshmanan, C.; Miller, F. P.** Relative adsorption and desorption of strontium and calcium to and from soils and soil clays—Column saturation-displacement and acid displacement: Soil Sci., v. 107, no. 3, p. 206-212, illus., tables, 1969.

Column leaching indicated marked preferential adsorption of Ca in the A horizon, small preferential Sr adsorption in the B horizon and equal adsorption of Ca and Sr in the C horizon. Acid-leaching eliminates the preferential adsorption of Ca in the A horizon.—JWH

Meason, J. L. *See* Reynolds, M. A. 02559

02574 **Menard, H. W.; Atwater, Tanya.** Origin of fracture zone topography: Nature, v. 222, no. 5198, p. 1037-1040, illus., 1969.

With minor modifications the hypothesis of sea-floor spreading can account for many characteristics of fracture zones, including creation and termination of zones, variations in length and spacing, regional differences in depth, great straight scarps and variations in scarp height, occurrence and orientation of rifted zones containing great linear ridges and troughs, and existence and location of abrupt changes in direction along the strike.—DBV

02502 **Merkel, Richard H.; Alexander, Shelton S.** Use of correlation analysis to interpret continental margin ECOOE refraction data: Jour. Geophys. Research, v. 74, no. 10, p. 2683-2697, illus., tables, 1969.

Numerical time series analysis has been used to study refraction records from a series of explosions on the continental margin off Maryland. Correlation filters made it possible not only to find arrivals buried in the noise but also to distinguish between arrivals that were nearly simultaneous. Velocity-depth calculations were made using the intercept times and velocities obtained from traveltime curves based on visually- and on machine-picked data. The M-discontinuity dips toward the continent at about 4° and is nearly 25 km deep in the Maryland area. The definition of the M-discontinuity has considerable north-south dependence in both energy and frequency content of its refraction arrival. The layer overlying the M-discontinuity dips west under the shelf area and under Maryland, whereas the shallowest observed refractor dips west on the shelf and east under the coast. Both layers strike approximately north-south in each region.—DBV

02407 **Merrill, R. T.; Gromme, C. S.** Nonreproducible self-reversal of magnetization in diorite: Jour. Geophys. Research, v. 74, no. 8, p. 2014-2024, illus., 1969.

The outer rim of the Bucks batholith in northern California consistsof a hornblende-biotite quartz diorite that contains both a reversely magnetized ilmenohematite (5 to 10 mol percent ilmenite in solid solution with hematite) and a normally magnetized magnetite. It is argued that the ilmenohematite has self-reversed in some manner that is not reproducible in the laboratory. The mechanism for this self-reversal probably involves a negative exchange interaction between a Ti ordered phase and a Ti disordered phase.—Authors' abstract

Messina, Angelina R. *See* Ellis, Brooks F. 02328

02055 **M'Gonigle, John W.** Boundary of the Late Precambrian craton and Paleozoic Wyoming shelf in southwestern Montana [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 53, 1969.

02331 **Miesch, A. T.** Teoria degli errori nei dati geochimici: Scuola Azione 1969, no. 2, p. 78-124, illus., 1969; originally published in English, 1967.

The original English version of this paper, "Theory of error in geochemical data," was published as U.S. Geol. Survey Prof. Paper 574-A, 1967. *See* Abstracts of North American Geology for August 1967.—VMJ

07585 **Miesch, A. T.; Connor, J. J.** Stepwise regression and nonpolynomial models in trend analysis: Kansas Geol. Survey Computer Contr. 27, 40 p., illus., tables, 1968.

Topics discussed are: conventional techniques of trend analysis, use of nonpolynomial terms in the general linear model, stepwise regression, matrix condition, and significance of the condition value. Examples used are the Lost Springs area, east-central Kansas, and the Lansing Group in Kansas. The first shows that the mathematical form of the trend function is of little importance in determination of the residual configurations. In the second example, the configurations of the trend residuals are, in part, extremely sensitive to the type trend function fitted to the data. The proper use of trend analysis appears to be as a method of exploring numerical map data rather than as a routine analytical procedure.—ESL

02056 **Miller, C. Dan.** Chronology of neoglacial moraines in the Dome Peak area, North Cascade Range, Washington [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 53-54, 1969.

Miller, F. P. *See* McLean, E. O. 02172

07670 **Miller, Halsey W.** *Youngquistina mitteni*, new genus and species of chordate from the Harding Sandstone (Ordovician) of Colorado: Kansas Acad. Sci. Trans., v. 71, no. 4, p. 504-508, illus., 1968. 02346

An *Archaeognathus*-like chordate is examined, which was discovered by Robert Mitten, in hand specimens collected by students in 1966 near Canon City, Colo. Named for Walter Youngquist, conodont scholar, it is a small bonelike fragment, horseshoe-shaped, bearing 7 cone-shaped phosphatic denticles. It differs from *Archaeognathus primus* Cullison by lack of striae and carinae, and by its denticles being curved and on the upper surface; they are similar in being acrodont, the same size, and hollow-based. There is no similarity of the Harding Sandstone "jaw" to any of the described conodonts from that formation. It is quite probable that conodonts, *Archaeognathus*, and *Youngquistina* are not vertebrate remains but fragments of chordates, possibly internal supporting structures of an as yet undetermined non-vertebrate member of Chordata.—GDC

Milligan, James H. *See* Williams, J. Stewart. 02215 02533

Mills, W. R. *See* Hilchie, D. W. 02358

02522 **Mining Engineering.** Building blocks of industry—Industrial minerals in 1968: Mining Eng., v. 21, no. 1, p. 51-76, illus., tables, 1969.

In this annual review of the industrial minerals, individually authored short sections cover the following commodities: asbestos; bastnasite; bauxite; bentonite; boron; cement; diatomite; dimension stone; fly and bottom ash; gypsum; kyanite and related minerals; lime, limestone and dolomite; lithium; magnesium compounds; mica; phosphate; potash; salt; quartz crystal; silica; structural mineral aggregates; sulfur; talc, soapstone and pyrophyllite; titanium; zeolites; zircon and hafnium. Phosphate, potash, and sulfur, the much sought after minerals of past years are now in oversupply.—FCC

07627 **Misaqi, F. Leo** (Fazlollah Missaghi). Geochemical and biogeochemical studies in the Eagle Nest quadrangle, New Mexico: New Mexico Bur. Mines and Mineral Resources Circ. 94, 24 p., illus., tables, 1968. 02530

A geochemical study of bedrock, soil, and plant samples of the area was conducted. The northwestern and north-central parts of the area, known for its mineralization, showed a conspicuous anomaly in metal content. The southwestern part of the area indicated an anomalous metal content. A further, detailed, large-scale study of the southwestern area of the Eagle Nest quadrangle is recommended.—Author's abstract 07695

02511 **Molnar, Peter; Oliver, Jack.** Lateral variations of attenuation in the upper mantle and discontinuities in the lithosphere: Jour. Geophys. Research, v. 74, no. 10, p. 2648-2682, illus., tables, 1969.

This study demonstrates the existence and determines the pattern of local variations of attenuation in the uppermost mantle on a worldwide scale, mainly on the basis of a comparison of gross charts of the Sn phase for more than 1,500 paths. Attenuation in the uppermost mantle is found to be more pronounced across the crests of mid-ocean ridges and the concave sides of island arcs. If low attenuation correlates with high strength, the strong outer shell (lithosphere) in the mantle has gaps at the ridges and island arcs. Any gap at transform faults is very narrow. As previously observed in the Tongan and Japanese arcs, one piece of lithosphere has underthrust another to great depth in the Mariana, New Britain, Solomon, and South American arcs, in accord with recent ideas on sea-floor spreading.—DBV 02274

02374 **Monroe, John N.** Slumping structures caused by organically derived gases in sediments: Science, v. 164, no. 3886, p. 1394-1395, illus., 1969. 07595

The interstitial waters of many sediments are saturated with methane derived from the decay of included organic material. Further generation of methane or local pres-

sure reduction results in sediment dilation and loss of sediment stability. The grains of sediment separated by gas behave in toto as an elastic fluid, and typical "slumping structures" result.—Author's abstract

02346 **Monroe, Watson H.** Geologic map of the Aguadilla quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I-569, scale 1:20,000, text, 1969.

Volcanic rocks exposed near the southeastern corner of the Aguadilla quadrangle are tightly folded, locally overturned, and cut by several faults. Oligocene and Miocene strata on the eastern edge have a northerly dip of less than 1° in the north to about 4° in the southern part of barrio Caimital Bajo. Oligocene strata rest with angular unconformity on underlying volcanic rocks. Steep slopes on the escarpment east of Victoria are covered by landslide blocks of all sizes consisting of limestone and calcareous clay. Economic resources are limestone from outcrop belts of the Aguada and Aymamon Limestones, small quantities of sand and gravel from the San Sebastian Formation and terrace deposits of Río Culebrinas, and fill and aggregate in the Aymamón Limestone upper member.—MCM

02533 **Monroe, Watson H.** Geologic map of the Moca and Isabela quadrangles, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I-565, scale 1:20,000, text, 1969.

Map units described in the text range from Tertiary tuffaceous sandstone and siltstone to Quaternary beach deposits. Oligocene and Miocene strata strike nearly due east and dip north over most of the two quadrangles. Volcanic rocks in the southwestern area are complexly folded and faulted, but exposures are insufficient to work out structure in detail. Very large quantities of limestone are available in outcrop belts of the Aguada and Aymamón Limestones. Extensive sand dunes bordering northern beaches can provide large quantities of shell sand for concrete manufacture. Quarries supplying fill material have been opened in outcrop belts of the Aymamón Limestone and Camuy Formation. Slopes of calcareous clay overlain by limestone tend to flow and sluff off downhill when saturated, causing landslide blocks.—MCM

Montagne, J. M. *See* Bailey, R. L. 02122

02530 **Montgomery, Gill.** Fluorspar—Domestic and foreign: Mining Eng., v. 21, no. 3, p. 63-66, illus., table, 1969.

Domestic consumption of fluorspar continued to increase through 1968 and there was also a sharp pickup in fluorspar mining activity. Illinois again furnished the great preponderance of domestic production. Kentucky was in second place, but Colorado promises to supplant Kentucky in 1969.—FCC

07695 **Moore, Donald B.; Joiner, Thomas J.** Subsurface geology of southeast Alabama: Alabama Geol. Survey Map 61, scale about 1 in. to 7 1/2 mi., text [1968?].

A subsurface study of Upper Cretaceous rocks in southeastern Alabama was made to evaluate petroleum potential and provide structural information for ground water and mineral exploration. The five maps show top of Tuscaloosa Group, base and top of Selma Group, thickness of interval between base of Selma and lower Tuscaloosa, and thickness of Selma Group. Most structures in the Lower Cretaceous Series or in younger sediments of the salt basin are the result of movement of the underlying Jurassic Louann Salt; except in Escambia County, basement movement is largely responsible for structure in overlying sediments. Additional test drilling and geophysical work is needed for more detailed evaluation. The Pollard oil field proves existence of source and reservoir beds in the western section.—MCM

02274 **Moore, George W.** New formations on Kodiak and adjacent islands, Alaska, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1967: U.S. Geol. Survey Bull. 1274-A, p. A27-A35, illus., 1969.

07595 **Moore, Gerald K.; Marcher, Melvin V.** Geologic map of the Adams quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 303-SE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Adams quadrangle, Tennessee," by R. E. Hershey is cited separately.—MCM

07596 **Moore, Gerald K.** Geologic map of the Springfield North quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 306-SW, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Springfield North quadrangle, Tennessee," by R. E. Hershey is cited separately.—MCM

07597 **Moore, Gerald K.; Wilson, Charles W., Jr.** Geologic map of the Youngville quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 306-SE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Youngville quadrangle, Tennessee," by R. E. Hershey is cited separately.—MCM

02185 **Moore, Paul B.** The crystal structure of sapphirine: Am. Mineralogist, v. 54, nos. 1-2, p. 31-49, illus., tables, 1969.

Sapphirine is monoclinic, space group $P2_1/a$ with $a = 11.266(12)$, $b = 14.401(7)$, $c = 9.929(10)$ A, $\beta = 125.46(5)°$. The asymmetric unit contains $Mg_{3.5}Al_{9.0}Si_{1.5}O_{20}$ comprised of eight octahedra and six tetrahedra incorporated in a cubic close-packed array of oxygen atoms. Three-dimensional refinement with 2800 independent reflections from a Fiskenaesset, West Greenland, crystal, gave $R_{hkl} = 0.055$. The structure consists of octahedral walls running parallel to z, which are connected along y by a new kind of $[T_6O_{18}]$ tetrahedral chain. The crystallochemical formula is $M_7(M)O_3[T_6O_{18}]$ with the parenthetical octahedra between the walls. The site preferences appear to be a compromise between conditions of electro-neutrality and minimization of cation-cation repulsions.—*from* Author's abstract

02372 **Moore, Paul B.** Basic ferric phosphates—A crystallochemical principle: Science, v. 164, no. 3883, p. 1063-1064, illus., table, 1969.

A polyatomic complex of iron-oxygen octahedral face-sharing triplets corner-linked to four other octahedra occurs in the atomic arrangements of the basic Fe phosphates dufrenite, rockbridgeite, beraunite, and laubmannite. This complex is further knit together by the phosphate tetrahedra. The family of basic ferric phosphates arises from the variety of ways in which the complexes can be linked along a third "variable" crystallographic axis.—Author's abstract

07543 **Moore, Paul B.; Smyth, Joseph R.** Crystal chemistry of the basic manganese arsenates—[Pt.] 2, The crystal structure of eveite, $Mn_2(OH)(AsO_4)$: Am. Mineralogist, v. 53, nos. 11-12, p. 1851-1845, illus., tables, 1968.

Isotopy of eveite, $Mn_2(OH)(AsO_4)$ with andalusite and the olivinite group is confirmed. Refined structural parameters are given; angles for the Mn^r-O polyhedron deviate from a regular trigonal pyramid much as in andalusite. Sarkinite, the dimorph of eveite probably has the wagnerite structure, but has not been refined.—Authors' abstract

Moore, Richard T. *See* Wilson, Eldred D. 02563

02057 **Moore, William J.** Igneous rocks in the Bingham mining district, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 54, 1969.

02058 **Moores, E. M.; Scott, R. B.; Lumsden, W. W.** Late Tertiary tectonics and sedimentation, White Pine-Grant Range region, east central Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 54-55, 1969.

07524 **Moreland, Grover C.** Preparation of polished thin sections: Am. Mineralogist, v. 53, nos. 11-12, p. 2070-2074, illus., 1968.

Techniques are described for the preparation of polished thin sections suitable for examination in reflected and transmitted light and electron microprobe analysis. The techniques are designed to economize on irreplaceable material such as meteorites. Uniform polished surfaces of heterogeneous material containing silicates, sulfides, and metal particles are attained by three stages of polishing with diamond and alumina-abrasive cloths.—Author's abstract

Morgenstern, N. R. *See* Al-Dhahir, Z. A. 02166

02059 **Morris, Hal T.; Kopf, R. W.** Tintic Valley thrust and associated low-angle faults, central Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 55-56, table, 1969.

Morton, D. M. *See* Watson, K. D. 02184

02060 **Mowatt, Thomas C.; Hower, John.** Crystal-field theory and the geochemistry of transition elements in pyroxenes,Stillwater Complex, Montana [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 56, 1969.

02045 **Mower, Reed W.** Electric analog model in water-resources investigation of Salt Lake County, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 56-57, 1969.

07620 **Muehlberger, William R.** Geologic map, cross sections, and structure contour and tectonic map of the Brazos Peak fifteen-minute quadrangle, New Mexico and Colorado: New Mexico Bur. Mines and Geology Geol. Map 22, 3 sheets, scale 1:48,000 [1968?].

Mueller, R. G. *See* Bailey, R. L. 02122

Muffler, L. J. Patrick. *See* Keith, Terry E. C. 07537

02140 **Mullens, Thomas E.; Crittenden, Max D., Jr.** Cretaceous age of the Willard Thrust, Weber County, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 57, 1969.

Muller, J. E. *See* Armstrong, J. E. 02549

07560 **Munoz, J. L.** Physical properties of synthetic lepidolites: Am. Mineralogist, v. 53, nos. 9-10, p. 1490-1512, illus., tables, 1968.

X-ray and optical properties of synthetic lithium micas were obtained from the crystallization of bulk compositions on the binary joins polylithionite-trilithionite, polylithionite-muscovite, and trilithionite-muscovite at 2 kbar. In polylithionite the amount of F necessarily equals four atoms per unit cell. In trilithionite, the OH/F ratio is a function of the amount of F available in the starting material. No hydroxy lepidolite end members could be synthesized. Major discontinuities in plots of the *c* dimension versus composition appear to be related to composition. The relationship between composition and polymorphism is discussed with reference to both synthetic and natural materials.—JSH

02039 **Mutschler, Felix E.; Hite, Robert J.** Origin of the Meander anticline, Cataract Canyon, Utah,and basement fault control of Colorado River drainage [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 57-58, 1969.

Mutschler, Felix E. *See* Larson, Edwin E. 02072

Nagata, T. *See* Larson, E. 02341

07564 **Nakayama, F. S.** Calcium activity, complex and ion-pair in saturated $CaCO_3$ solutions: Soil Sci., v. 106, no. 6, p. 429-434, illus., tables, 1968.

In saturated $CaCO_3$ solution under partial pressure of 350 ppm CO_2, the Ca^{+2} form makes up 80 percent of the total Ca in solution. The remaining 20 percent is made up of $CaCO_3^o$ and $CaHCO_3^+$ species, with the $CaCO_3^o$ predominating. Under these conditions, suitable correction must be employed to get the actual Ca^{+2} concentration when the Ca activity cannot be measured directly.—JWH

Nathan, Alan. *See* Greenwood, J. Arthur. 02453

07653 **Neathery, Thornton L.** Sulfide mineralization in the Cragford district, Clay and Randolph Counties, Alabama: Alabama Geol. Survey Circ. 50, 52 p., illus., tables, geol. maps, 1968.

The mineralization, consisting of arsenopyrite and galena with subordinate amounts of sphalerite, chalcopyrite and pyrrhotite, and small amounts of gold and other sulfides, is disseminated in the lenticular quartz pods interleaved with phyllite and fine-grained schist. Quartz-sulfide zones are localized along broad zones of structural weakness in the Wedowee Formation. The district trends parallel to the northeasterly strike of the Alabama Piedmont. At least five or six major sulfide-bearing quartz zones are traceable across the district. Paragenesis is interpreted as including two stages of base metal deposition separated by a period of structural readjustment. Intermediate or subsequent metamorphism of the sulfides was not detected. An appraisal of the sulfide potential in the Cragford district should be based on recovery characteristics of all metals present in the mineral suites.—*from* Author's abstract

Nettleton, W. D. *See* Malcolm, R. L. 02381

Neumann, Gerhard. *See* Greenwood, J. Arthur. 02453

02426 **Newman, Karl R.** Palynology of interflow sediments from the Std. Oil Co. of Calif., Rattlesnake Hills No. 1 well, Benton County, Washington [abs.]: Northwest Sci., v. 43, no. 1, p. 41, 1969.

Nichols, T. C. *See* Wahlstrom, E. E. 07512

02034 **Nicol, Alan.** Detection of pre-slip rotational strains in unstable slopes [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 58, 1969.

Nitecki, Matthew H. *See* Rigby, J. Keith. 07652

Niven, David. *See* Gries, J. P. 02090

07690 **Noble, Calvin A.; Palmquist, Robert C.** Meander growth in artificially straightened streams: Iowa Acad. Sci. Proc. 1968, v. 75, p. 234-242, illus., 1968.

Two rivers near Ames, Iowa, artificially straightened in 1900, are developing a meandering pattern. Meander amplitudes and wavelengths and channel widths were measured on aerial photographs taken in 1939, 1953, 1958 and 1966. Linear regressions between meander parameters and time, distance downstream from a bend, channel width-depth ratio, bank materials and discharge indicate that rate of meander development decreases with distance from a bend in the channel, meander amplitude increases more rapidly with time than does meander wavelength, meander amplitude increases most rapidly in channels with low width-depth ratios and meander wavelength increases most rapidly in channels with high width-depth ratios. Bank materials and discharge did not provide close correlations. Very wide channels cut into sands did not develop meanders because excess energy was expended in moving bedload.—Authors' abstract

07551 **Noble, Donald C.** Stress-corrosion failure and the hydration of glassy silicic rocks: Am. Mineralogist, v. 53, nos. 9-10, p. 1756-1759, 1968.

The relation between stress-corrosion, hydration, and concentration of phenocrysts in glassy silicic rocks is discussed, qualitatively.—JLH

02035 **Noble, James A.** Metal provinces of the western United States [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 58-59, 1969.

Norberg, John R. *See* Dayharsh, Fred L. 02416

02427 **Nordstrom, Harold.** Structural analysis of tectonites in the Northport district, Washington [abs.]: Northwest Sci., v. 43, no. 1, p. 41, 1969.

02036 **Normark, William R.** Erosional deep sea fan valleys [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 59, 1969.

Norris, D. K. *See* Baer, A. J. 02398

07525 **Northwood, D. O.; Lewis, D.** Transformation of vaterite to calcite during grinding: Am. Mineralogist, v. 53, nos. 11-12, p. 2089-2092, illus., table, 1968.

During grinding, the rate of transformation of vaterite to calcite increases with increasing temperature over the range investigated, -70° to 200°C. X-ray line broadening studies indicate that the vaterite has microstrains. The authors conclude that impurities are necessary for the formation of the strained vaterite structure.—JSH

02037 **Norton, Denis L.** A hydrothermal convection system related to porphyry copper formation [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 59-60, 1969.

02454 **Nunnally, Nelson R.** Integrated landscape analysis with radar imagery: Remote Sensing Environment, v. 1, no. 1, p. 1-6, illus., 1969.

It is shown here that radar provides a means for delimiting varying associations of physical and cultural phenomena (field patterns, vegetation, roads, water bodies, and landforms) through outlining image variation in tone, texture, pattern, and shape. "Integrated landscape" is suggested as a name for the types of units delimited. A study of the Asheville Basin is cited to illustrate the method.—VSN

02271 **Nuttall, Brandon D.** Recent oil and gas development in Hopkins County, Kentucky, *in* Middle and Upper Pennsylvanian strata in Hopkins and Webster Counties, Kentucky—Geol. Soc. Kentucky, Ann. Spring Field Conf. 1969: [Lexington, Ky.] Kentucky Geol. Survey, p. 71-77, illus., 1969.

Hopkins County has produced some oil and gas for over 70 years. Exploration and development has increased since discovery of the Hanson pool in the north-central part of the county in 1962. Significant oil pools discovered since then, in the vicinity of this field trip, are Richland, Sugar Creek, Barnsley, and Mortons Gap; gas in commercial quantities has been discovered in the Barnsley, Sisk School, Ilsley, St. Charles West, and Richland South pools. Brief discussion of these pools presents a typical picture of the oil and gas economics of this county and of this general part of southwestern Kentucky. Producing formations are listed with depths; most of the traps are stratigraphic.—GDC

O'Connor, Howard G. *See* Jewett, John Mark. 07665

02176 **Oertli, J. J.** Direction of water flow and potential difference: Soil Sci., v. 107, no. 5, p. 315-322, illus., 1969.

The author shows that the gradient or difference in chemical potential does not indicate the direction of a reaction (such as water transport) if this reaction is coupled with other reactions. Water can move up the gradient of partial molal free energy and can gain free energy during this process. The author suggests applying the term "active water transport" to all uphill reactions.—JWH

02378 **Olcott, Perry G.** Water resources of Wisconsin—Fox-Wolf River basin: U.S. Geol. Survey Hydrol. Inv. Atlas HA-321, 4 sheets, scale about 1 in. to 16 mi., text, 1969.

Sheet 1 contains information and maps (bedrock and glacial geology, glacial drift thickness, soil permeabilities) on physical setting and the water system of the Fox-Wolf River basin. Sheet 2 summarizes water use and problems, and conclusions of the study. Sheet 3 refers to surface water. Sheet 4 on ground water includes information and maps on availability and quality of water from bedrock and glacial-drift aquifers. Yields of 500-1,000 gpm are available in the outwash area, except in the thin-drift area where range is from 100-500 gpm. Bedrock aquifers are present only in the southern half of the basin where yields vary from 10-1,000 gpm. In both types of aquifers water is generally of the calcium magnesium bicarbonate type, moderately hard, and with excessive iron locally.—MCM

Oliver, Jack. *See* Molnar, Peter. 02511

Oliver, Jack. *See* Isacks, Bryan. 02538

02038 **Olmore, Stephen D.** Gravity thrusting in the East Mormon Range and vicinity, Lincoln County, southern Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 60, 1969.

Ondrick, Charles W. *See* Griffiths, John C. 07588

02141 **O'Neill, J. Michael.** Structural geology of the southern Pilot Range, Elko County, Nevada, and Box Elder and Tooele Counties, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 61, 1969.

O'Neill, Michael J. *See* Woodward, Lee A. 02206

02240 **Oriel, Steven S.** Implications of Idaho-Wyoming thrust belt to eastern Great Basin [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 61-62, 1969.

02536 **Oriel, Steven S.** Geology of the Fort Hill quadrangle, Lincoln County, Wyoming: U.S. Geol. Survey Prof. Paper 594-M, p. M1-M40, illus., table, geol. map, 1969.

New mapping and drilling in the quadrangle, astride the Wyoming thrust belt-Green River Basin boundary, indicate 24,000 feet of Paleozoic and Mesozoic strata are more intensely deformed than previously recognized. Tertiary units help date the tectonism. The Hogsback fault, with 18,000 feet of throw, diminishes in dip westward from 50° to 10° and is a bedding-plane glide surface; movement was about 20 miles eastward probably in early to middle Paleocene time. Three higher faults with smaller throws—the Fort Hill, Meridian, and Pine Ridge—likely are slices of the Hogsback. A lower fault, the La Barge, has 3,000 feet of throw; movement was about 3-4 miles eastward in middle early Eocene time. Rocks in the quadrangle contain combustible gas, oil, helium, oil shale, coal, and phosphate.—SSO

07664 **Oros, Margaret O.; Beene, Douglas L.** Oil and gas developments in Kansas during 1966: Kansas Geol. Survey Bull. 190, 191 p., illus., tables, 1968.

In 1966 Kansas produced 103,713,256 bbl crude oil, worth more than 3 million dollars, 17.4 percent of which was from secondary recovery waterflood projects. In addition 126,323,680 bbl liquid hydrocarbons and 856,421,989 M cubic feet of natural gas were produced. New oil and gas fields totaled 143, extensions to producing fields, 116, and new pay zones, 58. Production of helium has increased 75 times in value since 1961. There were 16 underground natural gas storage areas and 10 underground storage areas for LPG products in operation.—*from* Authors' abstract

Ottaviani, Mario. *See* Kuo, John T. 02495

02359 **Overton, Harold L.; Gupta, Yugal.** Shaly sand logging and ionic absorption: Log Analyst, v. 10, no. 2, p. 3-6, illus., 1969.

In shaly sands the water salinity is lower as seen by the SP curve, since dispersed clay has the ability to bind both water and ions onto its surface. This water is still conduc-

tive, however, and causes the solid to conduct. The result is a lower formation factor. A formula in terms of porosity, clean formation factor, and SP reduction is given which yields improved water saturation information for shaly sands. For small SP reduction, another formula yields a quicker solution. These theoretical equations have been checked both in the laboratory and with field logs and found to be reasonably accurate.—*from* Authors' abstract

Ozima, Minoru. *See* Larson, E. 02341

Ozima, Mituko. *See* Larson, E. 02341

02467 **Page, Norman J; Riley, Leonard B.; Haffty, Joseph.** Platinum, palladium, and rhodium analyses of ultramafic and mafic rocks, from the Stillwater Complex, Montana: U.S. Geol. Survey Circ. 624, 12 p., illus., tables, 1969.

Analyses by a combination fire-assay-solution-optical emission spectrographic method of 137 rocks from the Stillwater Complex, Mont., indicate that platinum, palladium, and rhodium are preferentially concentrated in chromitite zones. The A chromitite zone (21 samples) has an average of 988.9 ppb (parts per billion, 10^{-9}) Pt, 2290 ppb Pd, and 245.9 ppb RH and reaches a maximum (to date) of 8,000 ppb Pt, 11,000 ppb Pd, and 1,700 ppb Rh.—Authors' abstract

02241 **Palmer, Dennis E.** Structure and stratigraphy of Stansbury Island, Tooele County, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 62, 1969.

02285 **Palmer, James E.; Williamson, Allen D.** Second day of field conference, *in* Middle and Upper Pennsylvanian strata in Hopkins and Webster Counties, Kentucky—Geol. Soc. Kentucky, Ann. Spring Field Conf. 1969: [Lexington, Ky.] Kentucky Geol. Survey, p. 20, 51-65, illus., 1969.

The Dawson Springs to White Plains route had four stops south of the Parkway to study in the Rialto mine area the No. 4 coal bed and overlying Tradewater Formation, Middle Pennsylvanian, and near Nortonville some "offset-continuation faults". No. 4, a coking coal known by a number of local names, is the lowest regionally persistent and minable Pennsylvanian seam at this southwestern margin of the Western Kentucky Coal Field. It lies 625 feet above the Mississippian System, at the base of the upper Tradewater bedded shale and silty sandstone, with the Curfew Limestone Member at variable levels above it in different locations. In the abandoned Blue Flame mine area of No. 9 coal, and other beds in the Lisman Formation, the South Graham fault scarp, exposed by strip-mining of No. 14 coal, contains the Madison Limestone Member.—GDC

Palmquist, Robert C. *See* Noble, Calvin A. 07690

Palta, J. P. *See* Abrol, I. P. 07566

Parker, P. L. *See* Sever, Judy. 02368

07599 **Parks, William S.** Geologic map of the Medon quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 439-NE, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Medon quadrangle, Tennessee," by C. R. Sykes is cited separately.—MCM

07600 **Parks, William S.** Geologic map of the Beech Bluff quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 446-W, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Beech Bluff quadrangle, Tennessee," by C. R. Sykes is cited separately.—MCM

07613 **Parks, William S.** Geologic map of the Rose Creek quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 4-NW, scale 1:24,000, separate text, 1968.

The text, "Mineral resources summary of the Rose Creek quadrangle, Tennessee, by C. R. Sykes is cited separately.—MCM

Parsons, Willard H. *See* Wayne State University. 07680

Pask, Joseph A. *See* Langston, Robert B. 02380

02462 **Paull, R. A.** Analysis of some aspects of geology summer field courses: Jour. Geol. Education, v. 17, no. 1, p. 17-23, tables, 1969.

A questionnaire was sent to 108 geology departments listed as offering a summer field course. Data from analysis of the 62 percent returned on courses conducted in 1967 are tabulated. These include, among others, the general program, staff to student ratios, student costs, and recent trends. This information can be used as a guideline for improvement or planning of field programs. Suggestions are made for holding down student costs.—ESL

02521 **Payne, A. L.** Exploration on pediments [abs.]: Mining Eng., v. 21, no. 1, p. 39, 1969.

Pearce, G. W. *See* Larochelle, A. 02386

07655 **Pearl, Richard M.** 1001 questions answered about the mineral kingdom (revised edition): New York, Dodd, Mead and Co., 326 p., illus., 1968; originally published 1959.

Scientific, industrial and commercial, cultural, and hobby aspects of the mineral kingdom are clarified in these answers to 1001 questions. Contents of chapters are: minerals and crystals, igneous rocks, meteorites, sedimentary rocks, metamorphic rocks, precious metals, base metals, iron and ferroalloy metals, rare and unusual metals, radioactive minerals, gems, industrial minerals and rocks, fossil fuels, mining and milling, water resources, and mineral collecting as a hobby. A bibliography and an index are appended.—MCM

Pease, Thomas E. *See* Greenwood, J. Arthur. 02453

Perkins, W. E. *See* Hargraves, R. B. 02506

Peterman, Z. E. *See* Barker, Fred. 02126

Peterman, Z. E. *See* Barker, Fred. 02127

Peterman, Z. E. *See* Rosholt, J. N. 02231

Petersen, C. F. *See* Ahrens, Thomas J. 02561

02242 **Petersen, Morris S.** The occurrence of ammonoids from the Lower Deseret Limestone, northern Stansbury Mountains, Tooele County, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 63, 1969.

02243 **Peterson, James A.** Cyclic carbonate mound facies, Permian Franson and Ervay Formations, western Wyoming and adjacent area [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 63, 1969.

Picard, M. Dane. *See* Babcock, G. B. 02121

Picard, M. Dane. *See* McCormick, C. D. 02139

02244 **Picard, M. Dane; High, Lee R., Jr.** Recognition of lacustrine rocks [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 64, 1969.

Picard, M. Dane. *See* High, Lee R., Jr. 02262

Pickett, G. R. *See* Wuenschel, P. O. 02499

02245 **Pierce, William G.** Tectonic denudation and related features of the Heart Mountain fault, northwestern Wyoming [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 64-65, 1969.

Pierson, Willard J. *See* Greenwood, J. Arthur. 02453

02246 **Pinnell, Michael.** Directional fabric of ash-flow tuffs studied by differential X-ray absorption [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 65, 1969.

07563 **Pirie, E.; Lin, K.; Taylor, D.** Soil density measurements with gamma-rays: Soil Sci., v. 106, no. 6, p. 411-414, illus., table, 1968.

It is shown that by restricting the scattering angle to less than 90°, instead of the conventional 180°, the "soil type" effect is minimized. It is also shown that the maximum counting rate is obtained at some specific density equal to 16/d, where *d* is the source to detector distance.—JWH

Pollock, D. W. *See* Dobell, J. P. 02529

02247 **Poole, F. G.; Shropshire, K. L.** Gartra Member of the Chinle Formation (Upper Triassic) south of Glenwood Springs, western Colorado [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 65-66, 1969.

Pooser, W. K. *See* Colquhoun, D. J. 02356

02167 **Poulovassilis, A.** Steady-state potential and moisture profiles in layered porous media: Soil Sci., v. 107, no. 1, p. 47-52, illus., 1969.

When water is moving at a constant rate through a porous column and draining to a stationary water table or evaporating at the surface, it is possible for a steady-state potential and moisture profiles to build up. The general shape of the profile depends upon the layer sequence, the flow rate, and the width of the layers.—JWH

02556 **Poulsen, Valdemar.** An Atlantic Middle Cambrian fauna from North Greenland: Lethaia, v. 2, no. 1, p. 1-14, illus., 1969.

A late Middle Cambrian fauna from Nyeboe Land, on the north coast of North Greenland, is dominated by agnostid trilobites (six species described), with a few paradoxidid fragments, two indeterminable ptychopariid cranidia, and inarticulate brachiopods; the fauna is shown to belong to the Atlantic faunal province. The *Ptychagnostus punctuosus* and *Jincella brachymetopa* zones are shown to be present; these correspond to the *Paradoxides davidis* and part of the *P. forchhammeri* zones in eastern North America. Worldwide distribution of the Atlantic Cambrian faunas, found adjacent to Pacific faunas in some regions, may have been controlled by a euxinic or partly euxinic environment which prevailed in the North American geosynclines and in the North Greenland geosyncline.—VMJ

Price, P. B. *See* Fleischer, R. L. 02345

Price, P. B. *See* Fleischer, R. L. 02448

07681 **Prinz, Martin.** Volcanic geology of the American Falls area, *in* Structures and origin of volcanic rocks, Montana-Wyoming-Idaho—Natl. Sci. Found. Summer Field Course 1968, Guidebook: Detroit, Mich., Wayne State Univ., p. 56-63, illus., 1968.

This one-day field trip has been added in the 1968 revision of the original 1965 guidebook. A stratigraphic section along the Snake River south of American Falls Dam, Idaho, and the lavas of King's Bowl Rift are examined. The section represents Pliocene to Holocene rocks of the Eastern Snake River Plain, including rhyolitic and basaltic tuffs, Quaternary basalt flows, many other types of basaltic rocks, and intercalated fluvial and lake sediments. The formations are described and the sequence of geologic events outlined, including volcanism, faulting, erosion, deposition, and drainage changes. Lavas of the King's Bowl, entirely of Holocene age, are symmetri-

cally related to an open rift zone, a southward extension of the Great Rift of the Craters of the Moon lava field. Geologic sketch maps and a columnar section are included.—VMJ

Prior, Stanley J., Jr. *See* Tuttle, Sherwood D. 07575

02248 **Prokopovich, Nikola P.** Pleistocene permafrost in California's Central Valley? [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 66, 1969.

02321 **Pryslak, A. P.** Docker Township, District of Kenora: Ontario Dept. Mines Prelim. Geol. Map P. 544, scale 1 in. to 1/4 mi., text, 1969.

02249 **Pyle, William D.; Waltz, J. P.** Formulas for estimating the thickness of alluvial deposits [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 66-67, 1969.

Querio, C. W. *See* Egleson, G. C. 02547

02177 **Raats, P. A. C.; Klute, A.** One-dimensional simultaneous motion of the aqueous phase and the solid phase of saturated and partially saturated porous media: Soil Sci., v. 107, no. 5, p. 329-333, illus., 1969.

Concepts of continuing mechanics of mixtures are used to construct a macroscopic theory describing the transport of water in a deforming porous medium. It is shown that in a coordinate system moving with a solid phase the water content satisfies the nonlinear diffusion equation.—JWH

02151 **Rabbitt, Mary C.** Scientific achievements of the four great western surveys, 1867-79 [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 67, 1969.

02537 **Rabbitt, Mary C.** John Wesley Powell—Pioneer statesman of Federal science, *in* The Colorado River region and John Wesley Powell: U.S. Geol. Survey Prof. Paper 669-A, p. 1-21, 1969.

07542 **Radcliff, Dennis; Berry, L. G.** The safflorite-loellingite solid solution series: Am. Mineralogist, v. 53, nos. 11-12, p. 1856-1881, illus., tables, 1968.

Electron microprobe analyses of transition metal diarsenide minerals shows there is complete solid solution between $CoAs_2$-$FeAs_2$, limited solution of Co in $NiAs_2$, and no solid solution between $FeAs_2$-$NiAs_2$. The only ternary Co-Fe-Ni diarsenide compositions are in the more cobalt-rich range (safflorite). X-ray diffraction data for synthetic and natural Co-Fe and Co-Fe-Ni diarsenides are correlated with chemical composition. The name safflorite is retained for natural $(Co,Fe,Ni)As_2$ compositions from 3-100 mole percent $CoAs_2$, with nickel from zero in low Co minerals to about 30 percent in low Fe minerals. Safflorite is dimensionally orthorhombic in the range from 97 to about 20 mole percent Fe and often measurably monoclinic in compositions lower in iron.—*from* Authors' abstract

02428 **Rahm, David A.** Post-Miocene erosion of basalt in southeastern Washington [abs.]: Northwest Sci., v. 43, no. 1, p. 42, 1969.

Ramp, Len. *See* Brooks, Howard C. 07628

07579 **Ramseier, René O.** Origin of preferred orientation in columnar ice, *in* Crystal growth 1968—Internat. Conf. Crystal Growth, 2d, Birmingham, U.K., 1968, Proc.: Jour. Crystal Growth, v. 3-4, p. 621-624, illus., table, 1968.

A general rule has been developed to account for the preferred orientation of naturally-occurring and laboratory-grown columnar ice. A reference plane is established which is normal to the segment of a grain boundary trace at the ice-water interface. For a particular grain and grain boundary, the critical region of the reference plane is

the quadrant bounded by z and y, y being directed towards the grain boundary. The preferred orientation can best be predicted by summing the crystallographic components c_z' and a_z' of these crystal axes whose projection onto the reference plane lies in the critical quadrant. Grain B will be wedged out by grain A where the sum of the crystallographic components in the z direction is greater for grain B than for A. The analysis indicates that the preferred orientation depends on the equilibrium profile of the grain boundary at the ice-water interface.—Author's abstract

Rand, John R. *See* Hurley, Patrick M. 02344

Rao, M. N. *See* Reynolds, M. A. 02559

02353 **Rawson, Jack.** Reconnaissance of the chemical quality of surface waters of the San Antonio River basin, Texas: Texas Water Devel. Board Rept. 93, 24 p., illus., tables, geol. map, 1969.

Kinds and quantities of minerals dissolved in surface waters of the San Antonio River basin are related principally to the geology of the area and to rainfall and streamflow characteristics. Municipal and industrial wastes have degraded the natural quality of water in some streams. Rocks exposed in the basin range in age from Cretaceous to Quaternary. The upper part of the basin is underlain by the Edwards and associated limestones and Glen Rose Limestone. Streams that traverse these outcrops usually contain less than 325 mg/l dissolved solids but are very hard. The chemical composition of water in streams that traverse younger formations in the central and lower part of the basin is variable; dissolved solids range from 200-500 mg/l.—*from* Author's abstract

Redman, M. J. *See* Lipson, Herbert G. 07580

07514 **Reed, John C., Jr.** Precambrian rocks, *in* A geophysical study in Grand Teton National Park and vicinity, Teton County, Wyoming: U.S. Geol. Survey Prof. Paper 516-E, p. E12-E14, tables, 1968.

The Precambrian sequence comprises a variety of gneisses, granodiorite and pegmatite intrusions, and dikes of basalt and diabase. The oldest and most widely exposed unit is a fine- to medium-grained gray biotite gneiss interlayered with hornblende and plagioclase gneisses and amphibolite. North of Leigh Canyon hornblende-quartz monzonite gneiss and biotite granodiorite gneiss are major components. The quartz monzonite displays foliation and lineation, and contacts with the layered gneiss are sharp or transitional. The granodiorite gneiss is strongly foliated and rudely layered, and contacts with the layered gneiss are gradational. Southeast of the Open Canyon fault coarse-grained, nonlayered weakly foliated hornblende-plagioclase gneiss is widely exposed. Contact relations between intrusions and gneisses indicate emplacement of granitic rocks after the last episode of folding and regional metamorphism.—BSH

Reed, Lawrence J. *See* Howe, George M. 07633

Reeher, J. R. *See* Heald, E. F. 02182

07657 **Reeves, C. C., Jr.** Introduction to paleolimnology—Developments in sedimentology 11: Amsterdam, London, and New York, Elsevier Publishing Co., 228 p., illus., tables, 1968.

The book is arranged in three main parts: (1) formation, quantitative description, and shape and development of lake basins; (2) lacustrine environment, the sediments (chemical precipitates and clastic), and depositional and erosional structures; and (3) Pliocene chronology; distribution, cause, and recognition of paleolakes; and paleoclimatic methods. The first two parts set the stage for the third.—ESL

Rehrig, William A. *See* Heidrick, Tom L. 02083

02250 **Rehrig, William A.; Heidrick, Tom L.** Regional fracture, vein and dike trends in Laramide age stocks of Arizona [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 68, 1969.

02251 **Repenning, C. A.; Cooley, M. E.; Akers, J. P.** Stratigraphy of the Chinle and Moenkopi Formations, Navajo and Hopi Reservations, Arizona, New Mexico, and Utah: U.S. Geol. Survey Prof. Paper 521-B, p. B1-B34, illus., table, geol. map, 1969.

The Chinle and Moenkopi Formations comprise a thick sequence of predominantly fluviatile shaly sandy beds; they are separated by a regional unconformity. The age of the Moenkopi is Triassic(?) where the basal Hoskinnini Member is present, and Early to Middle(?) Triassic elsewhere. In the southern and western parts of the area it consists of the Wupatki, Moqui, and Holbrook Members, and in Monument Valley of the Hoskinnini Member, and lower siltstone, middle sandstone, and upper siltstone members. In the Zuni Mts. a clastic sequence is referred to as the upper sedimentary rocks of the Moenkopi(?). The Chinle Formation (Late Triassic) consists of, in ascending order, the Shinarump, Mesa Redonda, sandstone and siltstone, Monitor Butte, Petrified Forest, Owl Rock, and Church Rock Members. All form a gradational, intertonguing sequence, although several unconformities are present.—BSH

Reveal, J. L. *See* Tidwell, W. D. 02216

02559 **Reynolds, M. A.; Rao, M. N.; Meason, J. L.; Kuroda, P. K.** Fissiogenic and radiogenic xenon in the chondrites Beardsley and Holbrook: Jour. Geophys. Research, v. 74, no. 10, p. 2711-2716, illus., tables, 1969.

The amounts of excess fissiogenic xenon (Xe-136f) and excess radiogenic xenon (Xe-129r) in the chondrites Beardsley and Holbrook have been measured to be Xe-136f $= 0.7 \pm 0.3$ and 0.7 ± 0.3, Xe-129r $= 2.0 \pm 0.8$ and 13.2 ± 2.9, respectively, in the unit of 10^{-12} cc STP per g. If Xe-136f and Xe-129r are the decay products of extinct radionuclides Pu-244 and I-129, respectively, produced in the galactic nucleosynthesis process, the Pu/Xe and I/Xe decay intervals for both these chondrites can be shown to be concordant at approximately 200 m.y.—Authors' abstract

07701 **Rhodes, J. R.; Furuta, T.** Multi-element portable radioisotope X-ray analyser for determination of copper, nickel, iron and manganese: Inst. Mining and Metallurgy Trans., Sec. B, v. 77, Bull. 744, p. B162-B165, illus., tables, 1968.

The main use of this portable analyzer is to make rapid shipboard analyses of pulps of manganese nodules for copper and nickel to better than 0.1 percent, and iron and manganese to better than one percent. The instrument is described and experimental results, including calibration curves for all four elements, are given. Overall standard deviations of corrected results are tabulated and are not significantly different from those due to counting statistics.—ESL

02187 **Ribbe, P. H.; Gibbs, G. V.** Statistical analysis and discussion of mean Al/Si-O bond distances and the aluminum content of tetrahedra in feldspars: Am. Mineralogist, v. 54, nos. 1-2, p. 85-94, illus., tables, 1969.

The Al content of aluminous feldspars is linearly related to the grand mean tetrahedral distance ($\overline{T\text{-}O}$) by the equation $Al/(Al+Si) = 6.58\ [(\overline{T\text{-}O}) - 1.605]$. Because data are restricted to the range 0.25-0.50 Al, errors associated with prediction of Al_t content of tetrahedron T_t, on extrapolated parts of the curve, increase with increasing difference from the mean value ($\overline{T\text{-}O} = 1.56$A; Al = 0.33) according to the equation *var* $(Al_t) \approx 44.0$ *var* $(T_t\text{-}O) + 0.034\ \{(\overline{T_t\text{-}O}) - 1.65\}^2$. If only random errors are important, there is no statistical basis for rejecting the linear model proposed by Smith and Bailey, which predicts partial disorder for low albite and maximum microcline, and by analogy with reedmergnerite should be completely ordered. Until electrostatic and covalent effects on the T-O bond are quantitatively understood, the linear model must be used with caution.—*from* Authors' abstract

Ribbe, P. H. *See* VanSchmus, W. R. 02484

02391 **Rice, Salem J.** Quartz family minerals: California Div. Mines and Geology Mineral Inf. Service, v. 22, no. 3, p. 35-38, illus., 1969.

Many varieties of quartz are technically rocks and many are semiprecious gem stones recognized long before systematic mineralogy. Specifically the quartz family minerals are quartz, tridymite, cristobalite, coesite, and stishovite, as well as opal. Briefly described here, they are divided into coarse-grained and fine-grained varieties, according to visibility of crystal faces or grains with and without a microscope. The process of silicification has often produced spectacular specimens. Present commercial uses of quartz are mentioned.—GDC

02460 **Richter, C. F.** Comments on paper by B. Isacks, J. Oliver, and L. R. Sykes, "Seismology and the new global tectonics" [1968]: Jour. Geophys. Research, v. 74, no. 10, p. 2786-2788, 1969.

The most significant questions in connection with the recent paper by Isacks, Oliver and Sykes (ibid., v. 73, no. 18, p. 5855-5899, 1968) arise with regard to the tectonics of Japan and the Alpide belt. Block faulting in the interior of island arc structures is not fully considered, and it is unsatisfactory to describe the Alpide belt as an area of scattered or diffuse seismicity. A distinction is desirable between swarms of small shocks preceding eruptions and events on a large scale (both in magnitude and in time) without any eruption; an island arc source may be involved, but the majority of the latter type of sequences are associated with oceanic ridges. Finally, longer rupture need not correspondingly increase the instrumental magnitude.—DBV

02142 **Rigby, J. Keith.** Lower Pennsylvanian sponges from Oklahoma [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 68, 1969.

07652 **Rigby, J. Keith; Nitecki, Matthew H.** Annotated bibliography of lower Paleozoic sponges of North America: Fieldiana—Geology, v. 18, no. 1, 146 p., 1968.

This bibliography on sponges of Cambrian, Ordovician, and Silurian ages in North America also includes works dealing with organisms which may not be sponges but that have been placed in the phylum Porifera by various authors. Although the authors do not consider receptaculitids to be related organisms, they have included references dealing with these forms because they have been traditionally considered as sponges, or as related sponge-like forms. The taxonomic position of receptaculitids and other problematic organisms will be considered in a later paper. The present work is a part of a larger compilation which will cover all Paleozoic sponges. —*from* Authors' introduction

Riley, D. L. *See* Herzenberg, C. L. 02336

Riley, Leonard B. *See* Page, Norman J. 02467

02337 **Ritzma, Howard R.; Seeley, deBenneville K.** Determination of oil shale potential, Green River Formation, Uinta Basin, northeast Utah: Utah Geol. and Mineralog. Survey Spec. Studies 26, 16 p., illus., geol. map, 1969.

Oil reserves, estimated from 120-1,300 billion bbl, are contained in the Eocene Green River Formation oil shales in northeastern Utah's Uinta Basin. Most estimates are based on extensive outcrop data and relatively abundant control from cores and oil and gas well cuttings in the eastern third; in the sparsely drilled western two-thirds where potential is not as well known, most oil shale is in the subsurface, much at depths exceeding 3,000 feet. Correlation of electric logs of deep oil and gas well tests in the western basin enables projection of stratigraphic trends into this area, shows progression of structural and depositional development of the basin, and indicates an area where thick, rich oil shale may be present. A generalized geologic map of the Green River Formation, thickness maps of five members, and one thickness map of the entire formation are included.—MCM

02577 **Ritzma, Howard R.; Doelling, Hellmut H.** Mineral resources, San Juan County, Utah, and adjacent areas—Pt. 1, Petroleum, potash, groundwater, and miscellaneous

minerals: Utah Geol. and Mineralog. Survey Spec. Studies 24, 125 p., illus., tables, 1969.

Potash, petroleum, natural gas, and ground-water resources are examined for the San Juan Project area in Utah and Colorado. The Pennsylvanian-Permian stratigraphy of the area is discussed in the section on potash, and the section on petroleum covers mostly exploration. An oil and gas field map and penetration chart accompany the report. Ground-water recharge areas are at high elevations or in alluvium along streams at flood stage; structure controls ground-water movement and principal avenues of movement are listed. Eight hydrologic units are described, and chemical analyses of ground and surface waters are tabulated. Miscellaneous mineral deposits discussed are: clay, coal, iron, semiprecious stones, gypsum, dimension sandstone, limestone, metals, and construction materials.—ESL

Roberts, R. J. *See* Tooker, E. W. 02217

02143 **Roberts, Ralph J.; Tooker, E. W.** Age and regional significance of conglomerate in the Newfoundland and Silver Island Mountains, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 69, 1969.

Robinson, C. S. *See* Wahlstrom, E. E. 07512

02203 **Robinson, P. D.; Fang, J. H.** Crystal structures and mineral chemistry of double-salt hydrates—[Pt.] 1, Direct determination of the crystal structure of tamarugite: Am. Mineralogist, v. 54, nos. 1-2, p. 19-30, illus., tables, 1969.

The structure of tamarugite, $NaAl(SO_4)_2 \times 6H_2O$, has been solved by reiterative application of Sayre's equation using three-dimensional photographic and counter data. The final *R* value is 7.3 percent (hydrogens included). The coordination polyhedra of sodium and sulphur are joined to form infinite chains parallel to *c*. The perfect (010) cleavage traverses only weak hydrogen bonds. The mean distances are: Na-O = 2.415, Al-Ow = 1.883 A, S-O = 1.488 A, and Ow-O = 2.65 A. The $Al(H_2O)_4$ octahedron and the two independent SO_4 tetrahedra are regular but the NaO_6 group deviates considerably from a regular octahedron.—Authors' abstract

07576 **Robinson, Peter.** Nyctitheriidae (Mammalia, Insectivora) from the Bridger Formation of Wyoming: Wyoming Univ. Contr. Geology, v. 7, no. 2, p. 129-138, illus., tables, 1968.

The entire Marsh collection of small, middle Eocene insectivores at Yale, made available recently, is classified, with others. Eighteen drawings of teeth are included, and measurements in millimeters of both upper and lower teeth are tabulated.—ESL

02230 **Robison, Richard A.; Sprinkle, James.** A new echinoderm from the Middle Cambrian of Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 69, 1969.

07567 **Roedder, Edwin; Dwornik, Edward J.** Sphalerite color banding—Lack of correlation with iron content, Pine Point, Northwest Territories, Canada: Am. Mineralogist, v. 53, nos. 9-10, p. 1523-1529, illus., 1968.

Normal sphalerite coloration—colorless through yellows to dark red-brown—has generally been attributed to iron content. Electron microprobe scanning and analyses of individual thin "colloform" bands show that although total iron content (<3 percent) does vary with the banding, it cannot be correlated with band color in these samples. The true coloring mechanism is not known.—Authors' abstract

02487 **Rogers, Thomas H.** Where does the Hayward fault go?: California Div. Mines and Geology Mineral Inf. Service, v. 22, no. 4, p. 54-60, illus., 1969.

In response to inquiries concerning this active fault, the accompanying generalized map was compiled, showing epicenters of moderate to great earthquakes, sites of slow aseismic fault movement where it has deformed man-made structures, and

points where geodimeter lines crossing faults have shortened or lengthened due to fault movement. It can be seen that modern movement has occurred along all three major faults of the San Francisco Bay area: Hayward zone—Richmond south to Berryessa Creek; Calaveras zone—Walnut Creek south to beyond Hollister; San Andreas—Laurel area on State Highway 17 southward to beyond Hollister. Geodimeter lines on the San Francisco peninsula, adversely affected by local conditions, were considered unreliable. An annotated list of the most recent maps is provided, categorized by fault zones.—GDC

Rogers, Thomas H. *See* Sackett, John. 02552

Ronai, Lili E. *See* Ellis, Brooks F. 02328

Rosenberg, J. T. *See* Ahrens, Thomas J. 02561

02231 **Rosholt, J. N.; Peterman, Z. E.** Uranium, thorium, lead systematics in the Granite Mountains, Wyoming [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 70, table, 1969.

Ross, C. S. *See* Bailey, R. A. 02515

02455 **Ross, Donald C.** Map showing recently active breaks along the San Andreas fault between Tejon Pass and Cajon Pass, southern California: U.S. Geol. Survey Misc. Geol. Inv. Map I-553, scale 1:24,000, text, 1969.

This strip map of the Tejon Pass-Cajon Pass area is the first of a set designed to show lines of most recent movements on the San Andreas fault. Fault traces identified on aerial photographs were transferred to topographic maps by visual inspection; therefore, map users should consider mapped lines as a field guide rather than as precisely located lines of faulting. The preserved traces of most recent faulting are a series of parallel, somewhat overlapping segments, generally 200-500 feet apart; lengths vary from 2.5 to 9 mi. The most striking feature is the presence on aerial photographs of a single well-defined recent fault strand. Other recently active breaks that have not produced distinctive surficial features may be present.—MCM

Ross, Malcolm. *See* Allen, Victor T. 02196

02441 **Roth, Eldon S.** Junior colleges: Geotimes, v. 14, no. 4, p. 17-18, tables, 1969.

In response to questionnaires concerning geological education in junior or community colleges, of the 878 listed in a 1967 Directory, 30.3 percent offer geology, but the curricula in general are limited to two introductory courses. Enrollments, tabulated for the last 7 years by 6 regions, have grown tremendously in the national total, and in majors from 1.3 percent to 1.8 percent. Facilities and equipment range from excellent to almost nonexistent; 38 percent of the instructors carry overloads, and academic preparation is varied. A Master's degree is standard, but nearly a third of those teaching geology have no degree in geology; 40 percent of all degrees were earned more than 10 years ago.—GDC

Roy, Rustum. *See* Dachille, Frank. 07534

Roy, Rustum. *See* Datta, R. K. 07570

Rubey, William W. *See* Hubbert, M. King. 02264

Rucklidge, J. *See* Stumpfl, E. F. 07559

02471 **Ruddiman, William F.** Recent planktonic Foraminifera—Dominance and diversity in North Atlantic surface sediments: Science, v. 164, no. 3884, p. 1164-1167, illus., 1969.

Foraminiferal dominance values above 50 percent and associated diversity minimums in surface sediments of the North Atlantic coincide with past extremes of

temperature, productivity, or salinity in overlying surface waters. These parameters delimit a cold Polar-Subpolar water mass and an impoverished, saline Southern Sargasso Central water mass for the late Recent. Anticipated pole-to-equator diversity and dominance gradients in the open ocean are virtually eliminated by the stronger trends of the vigorous subtropical North Atlantic gyre.—Author's abstract

07696 **Ruitenberg, A. A.** Geology and mineral deposits, Passamaquoddy Bay area: New Brunswick Dept. Nat. Resources Mineral Resources Br. Rept. Inv. 7, 47 p., illus., tables, geol. maps, 1968.

Rocks in southwestern New Brunswick and southeastern Maine range in age from Early Ordovician to Carboniferous. The stratigraphy is discussed for the Eastport, Maine, Passamaquoddy Bay, and Piskahegan-Rollingdam, New Brunswick areas. The regional structural geology is described, and the relationship of the nickel-copper, tin-molybdenum-base-metal, arsenopyrite-gold, and pyrite-pyrrhotite-base-metal mineralizations to major rock units and structures is discussed. Mineral deposits that occur in the Passamaquoddy Bay area are: sulfides on the Mascarene Peninsula and Ovenhead prospect, Letang limestone, and St. George granite.—ESL

07698 **Rush, F. Eugene.** Index of hydrographic areas in Nevada: Nevada Div. Water Resources, Water Resources-Inf. Ser. Rept 6, 38 p., illus., tables, 1968.

This report contains a map and three tables showing and describing the 14 hydrographic regions and basins and the 253 hydrographic areas of Nevada. The map was compiled by personnel of the U.S. Geological Survey and the State Engineer's office and was distributed by the State in January 1968. This report and the map have been prepared as a guide to all water-resources and other natural-resources and research agencies. The tables present selected information on geographic features of each area and list the hydrologic reports prepared by the U.S. Geological Survey that were published by the State and Federal Governments. Alphabetical and county lists of areas are included also.—Author's abstract

Rushforth, S. R. *See* Tidwell, W. D. 02216

Rushforth, Samuel R. *See* Tidwell, William D. 02147

07614 **Russell, Ernest E.** Geologic map of the Mt. Peter quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 12A-SE, scale 1:24,000, separate text, 1968.

"Mineral resources summary of the Mt. Peter quadrangle, Tennessee," by L. T. Larson, the accompanying text, is cited separately.—MCM

02198 **Rutstein, Martin S.; Yund, Richard A.** Unit-cell parameters of synthetic diopside-hedenbergite solid solutions: Am. Mineralogist, v. 54, nos. 1-2, p. 238-245, illus., tables, 1969.

Unit-cell parameters for synthetic members of the diopside-hedenbergite series have been determined by least-squares refinement for 26 samples consisting of 11 compositions. Within the experimental error, the cell volume and cell edges a and b appear to change linearly over the entire compositional interval, although β does not. The c dimension is not sensitive to the Mg/Fe ratio. No significant difference was observed for samples synthesized on different oxygen buffers. Four reflections were used to test the validity of a spacing curve for estimating the composition of clinopyroxenes from the calc-silicate skarns. Eight samples from Willsboro, New York indicate that the composition of clinopyroxenes coexisting with wollastonite and garnet can be estimated to within ± 5 mole percent if elements other than Ca, Fe, Mg, Si, and O are known to be present in only very low concentrations.—Authors' abstract

02350 **Rvachev, V. D.** O nekotorykh chertakh geomorfologii shel'fa i materikovogo sklona N'yufaundlendskogo i Labradorskogo rayonov [with English summ.]: Okeanologiya, v. 8, no. 4, p. 659-665, illus., 1968; English translation, Oceanology, v. 8, no. 4, p. 529-534, 1969.

The submarine borderland of Newfoundland and Labrador is characterized by transverse and longitudinal channels in a relatively smooth shelf surface; the channels are due to the geologic structure and distribution of the adjacent land. Banks and transverse channels of the shelf northwest of Newfoundland are on the submarine extension of the submerged Appalachians and correspond to elevations and depressions of fracture zones. Irregular relief of longitudinal channels is a late postglacial modification possibly caused by revival of preglacial depressions at the land-sea boundary superimposed on tectonics of the North American platform. Movements at the continental borderland may have been reinforced by glacial degradation and by replacement of ice load by the transgressing postglacial sea.—*from* Author's English abstract

02552 **Sackett, John; Rogers, Thomas H.** (compilers). Index to graduate theses on California geology, 1966 and 1967: California Div. Mines and Geology Mineral Inf. Service, v. 22, no. 6, p. 91-95, 102, 1969.

This is the second supplement to California Div. Mines and Geology Spec. Rept. 74, Jennings, 1963; the first supplement appeared in California Div. Mines and Geology Mineral Inf. Service, v. 20, no. 8, 1967 (Kobal). This index contains 168 thesis titles on geology and related sciences. Part 1 lists theses regarding specific areas indicated on an accompanying map; part 2 contains broad regional or topical studies.—MCM

Sackin, M. J. *See* Harbaugh, J. W. 07587

02534 **Sainsbury, C. L.** Geologic map of the Teller B-4 and southern part of the Teller C-4 quadrangles, western Seward Peninsula, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-572, scale 1:63,360, 1969.

07650 **Sainsbury, C. L.; Hamilton, J. C.** The geology of lode tin deposits, Paper 15 *in* Technical conference on tin, London, 1967, V. 1: London, Internat. Tin Council, p. 313-346, illus., tables; discussion, p. 347-349, 1968.

The world's principal tin lodes are closely related to biotite granite or subvolcanic rocks along major orogenic belts. In the broader Precambrian belts, most deposits are in pegmatite with heavy minerals; post-Cambrian rock types are: contact metamorphic, pneumatolytic-hydrothermal, subvolcanic or tin-silver, fumarolic, and disseminated. Commonly localized in warmer or deeper parts of lodes, tin deposits grade up- and outward into copper and tungsten deposits. Recent geochemical exploration in the Seward Peninsula revealed zoning relations of tin deposits that contain tungsten and grade laterally into veins rich in beryllium and fluorite. Prevailing views on the genesis of tin deposits are inadequate to explain all facts observed in lodes; evidence points to magmatic emanations from depths carried up through crustal fractures.—GDC

Saint-Onge, D. A. *See* Scott, J. S. 02382

02232 **Sandberg, Charles A.; Gutschick, R. C.** Stratigraphy and conodont zonation of type Leatham Formation (Devonian and Mississippian), Bear River Range, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 70-71, 1969.

07556 **Santos, E. S.** Reflectivity and microindentation hardness of ferroselite from Colorado and New Mexico: Am. Mineralogist, v. 53, nos. 11-12, p. 2075-2077, illus., 1968.

For samples of ferroselite overgrowths on marcasite, reflectivity was found to be 50 ± 1.2 percent (Colorado) and 47 ± 1.2 percent (New Mexico). Microindentation hardness (Vickers hardness, 25 gm load) was 897 but ranged from 858 to 933.—JLH

Satyanarayana, K. V. S. *See* Krishna Murti, G. S. R. 02300

02508 **Savage, J. C.** A new method of analyzing the dispersion of oceanic Rayleigh waves: Jour. Geophys. Research, v. 74, no. 10, p. 2608-2617, illus., tables, 1969.

For the period range from about 25 sec to perhaps 80 sec, the group velocity U for oceanic Rayleigh waves may be approximated as a function of frequency f by $1/U = 1/U_o + B(f-f_o)^2$. The subscript o refers to the group velocity maximum. A simple method of analyzing the Airy phase to obtain the constants U_o, B, and f_o is shown. The fit is easily checked by calculating a synthetic seismogram to be compared with the original. In a study of 18 Rayleigh wave trains that had traversed different parts of the Pacific basin, the following ranges of values were found: U_o, 3.88-4.12 kmps; T_o $(=1/f_o)$, 26.8-43.1 sec; and B, 24-107 sec^3 per km.—Author's abstract

07638 **Sawkins, F. J.** The significance of Na/K and Cl/SO_4 ratios in fluid inclusions and subsurface waters, with respect to the genesis of Mississippi Valley-type ore deposits: Econ. Geology, v. 63, no. 8, p. 935-942, 1968.

Chemical similarities between inclusion fluids and connate brines, and the presence of petroleum droplets, show that connate waters were present during ore deposition. The Na/K and Cl/SO_4 ratios of inclusions, however, are lower than those of connate brines, and closer to those of volcanic or magmatic fluids. Na/K ratio may also result from differential solution of evaporite sediments. A model involving mixing of average connate water (3 parts) and hydrothermal solutions related to cooling magmas (1 part) seems to fit inclusion data best. Alkalic intrusions of the craton are a possible source of magmatic water.—WSW

07555 **Saxena, S. K.** Distribution of iron and magnesium between coexisting garnet and clinopyroxene in rocks of varying metamorphic grade: Am. Mineralogist, v. 53, nos. 11-12, p. 2018-2024, illus., table, 1968.

The distribution of Fe and Mg between coexisting garnet (with little Mn) and clinopyroxene in rocks of glaucophane schist facies, granulite facies, and eclogites is studied. The average distribution coefficient (Fe-Mg) in each of the following cases —glaucophane schist facies, granulite facies and in certain eclogites—is distinctly different. This difference could not be correlated with variation in the concentration of Ca in garnet and is probably due to changing p and T. The variation in the distribution coefficient in several eclogitic rocks, however, is difficult to interpret at present. – Author's abstract

Sayegh, A. H. *See* Harward, M. E. 02379

02482 **Scadden, E. M.** Rhenium—Its concentration in Pacific Ocean surface waters: Geochim. et Cosmochim. Acta, v. 33, no. 5, p. 633-637, table, 1969.

The average Re concentration in four widely-spaced Pacific Ocean surface sea water samples was found to be 0.0084 μg per 1 ± 17 percent. The amount of Re found in (or on) a brown kelp plant (*Macrocystisintegrifolia*) was 0.022 μg per g freeze-dried plant. The Re in sea water was found to exist as an extractable species.—Author's abstract

02548 **Scharon, LeRoy; Hsu, I-Chi.** Paleomagnetic investigation of some Arkansas alkalic igneous rocks: Jour. Geophys. Research, v. 74, no. 10, p. 2774-2779, illus., tables, 1969.

Remanent magnetization (RM) properties have been determined at 19 sites in 2 alkalic igneous complexes at Magnet Cove and Potash Sulphur Spring, Ark. The Magnet Cove intrusion has been dated by K-Ar, Rb-Sr, and fission-track methods. The average age from 6 age dates is 98 m.y. (early Late Cretaceous). All specimens were demagnetized in various alternating peak fields and yield 19 site-mean RM directions. The paleomagnetic pole calculated from the mean of these 19 site-means is at 65.1° N. and 173.3° W. with confidence oval semiaxes 8.8° and 12.5°, respectively. This pole agrees with other North American Cretaceous poles and hence further supports the conclusion that the geomagnetic field during Late Cretaceous is dipolar and stable. It also suggests that central Arkansas has been stable since early Late Cretaceous.—Authors' abstract

07630 **Scheidegger, Adrian E.** Random graph patterns of drainage basins [with French abs.], *in* Hydrologic aspects of the utilization of water—Gen. Assembly of Bern, 1967: Internat. Assoc. Sci. Hydrology Pub. 76, p. 415-425, illus., tables, 1968.

Graph theory is applied to drainage basins. As a stochastic hypothes, the postulate is introduced that all possible graphs (i.e. arborescences with a given number *N* of pendant vertices) are equally likely as representatives of a river network with *N* first-order streams. This enables one to predict expectation values for certain observable quantities, such as for the bifurcation ratio which can give a rational explanation of Horton's law of stream numbers.—Author's abstract

Schmitt, R. A. *See* Loveland, W. 02442

Schneider, G. B. *See* Bailey, R. L. 02122

02492 **Schneider, Robert F.** A coring device for unconsolidated lake sediments: Water Resources Research, v. 5, no. 2, p. 524-526, illus., 1969.

A piston-type coring device for unconsolidated bottom deposits is described. The apparatus is a modification of the lightweight Livingstone corer. The coring tube is clear plastic, allowing visual examination of the core before extrusion, and the piston contains a vacuum release tube to prevent expansion of the cored material during removal of the piston. It is easily constructed, requiring no special machining, and is therefore relatively inexpensive compared with other similar coring devices. —Author's abstract

07522 **Schryver, K.** Precision and components of variance in the modal analysis of a coarse-grained augen gneiss: Am. Mineralogist, v. 53, nos. 11-12, p. 2036-2046, tables, 1968.

Point counting of large stained slabs under a microscope is recommended for rocks that are so coarse-grained as to require a very large number of thin sections per specimen for a moderately precise estimate of their mode, but not so coarse-grained as to make field identification of minerals a reliable procedure. The method is applied to a quartz-mangeritic augen gneiss, and the variability between the specimens is broken down into components of variance: The operator plus counting component is not significantly different from binomial expectation; the within-specimen component is used to predict the number of slabs required to obtain a mode of given precision; the between-specimen component is unknown, but a rough estimate of its maximum size is possible for designing sampling plans in similar rocks.—*from* Author's abstract

07651 **Schuiling, R. D.** Tin belts around the Atlantic Ocean—Some aspects of the geochemistry of tin, Paper 24 *in* Technical conference on tin, London, 1967, V. 2: London, Internat. Tin Council, p. 529-547, illus.; discussion, p. 548-550, 1968.

Data compiled on the geographical distribution of tin occurrences of both economic and mineralogical interest are presented in figures for the continents of Europe, Africa, North America and South America. In North America the Rocky Mountain belt, similar to the Andean belt but less productive, has a small branch to Colorado and South Dakota; the Appalachian belt extends from Alabama to Nova Scotia, its southern end disappearing under the Mississippi delta. A closer definition of tin belts may be achieved by analysis of tin in biotite in granites; Arizona data are tabulated. By physico-chemical investigations the actual process of tin mineralization can be better understood. Where belts strike into oceans, there may have been former continental connection.—GDC

02364 **Schwalb, Howard R.** Catalog of Devonian and deeper wells in western Kentucky: Kentucky Geol. Survey, ser. 10, Inf. Circ. 17, 17 p., tables, 1969.

This catalog [by county] of wells drilled to the New Albany Shale and stratigraphically deeper formations has been compiled from various sources of information, the more reliable data being chosen where discrepancies were discovered. Where

mechanical logs are known to have been run, this information is indicated, but not all of these logs are available. Existing sample sets and drillers logs are also indicated, as these are the most numerous sources of formational data.—*from* Author's introduction

Schwander, H. *See* Wenk, E. 07554

Schwartz, Robert K. *See* Suttner, Lee J. 02229

02382 **Scott, J. S.; Saint-Onge, D. A.** Guide to the description of till: Canada Geol. Survey Paper 68-6, 15 p., illus., 1969.

This manual outlines a standard method for describing essential features of till which distinguish it from other sediments, and permit objective comparison between tills. Intended primarily for field use, procedures and measurements have been kept as simple as possible; appropriate laboratory tests are listed also. The methods suggested provide the basic data required by all disciplines. Widespread use of these methods will eventually permit critical comparisons and a more precise definition and classification of till.—GDC

07531 **Scott, Kevin M.; Gravlee, George C., Jr.** Flood surge on the Rubicon River, California—Hydrology, hydraulics and boulder transport: U.S. Geol. Survey Prof. Paper 422-M, p. M1-M40, illus., tables, 1968.

The failure of Hell Hole Dam December 23, 1964 provided an opportunity to study sedimentologic and geomorphic effects of a catastrophic flood. Erosion of canyon walls resulted in thalweg aggradation at five cross-profile sites and a pronounced change in channel morphology. Depositional forms and flow dynamics were strongly influenced by local sources of sediment. Boulder berms are believed to represent deposition by subaqueous rockflows. Movement of rockfill particles from the damsite indicated that rapid changes in roundness occurred and that the downstream decline in particle size was due to progressive sorting under decreasing competency rather than abrasion and breakage. Maximum distance of transport for any identifiable particle was 2.1 miles. Thus, naturally occurring catastrophic floods may greatly influence the morphology of mountain streams but be unimportant in terms of total sediment transport.—*from* Authors' abstract

Scott, R. B. *See* Moores, E. M. 02058

02233 **Seeland, David A.** Marine shelf current directions determined from crossbedding in three Upper Cambrian to Lower Ordovician sandstones, Black Hills, South Dakota [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 71, 1969.

Seeley, deBenneville K. *See* Ritzma, Howard R. 02337

07589 **Sendlein, Lyle V. A.** The bedrock configuration of Iowa: Iowa Acad. Sci. Proc. 1968, v. 75, p. 190-196, illus., 1968.

A review of bedrock topographic mapping of Iowa indicates that less than half of the state has been mapped. A map compiled primarily from the published literature of the bedrock configuration of Iowa and segments of the adjacent states of Minnesota, Illinois, Missouri and Nebraska suggests that the bedrock valley pattern parallels modern drainage as hypothesized by Kay and Apfel, in 1928. An unpublished map by Hale (1950) captured major valley trends remarkably well for the limited amount of data available. Studies of the bedrock surface by the United States Geological Survey in cooperation with the Iowa Geological Survey and by the Hydrogeology Research Group at Iowa State University are presently being conducted.—Author's abstract

02368 **Sever, Judy; Parker, P. L.** Fatty alcohols (normal and isoprenoid) in sediments: Science, v. 164, no. 3883, p. 1052-1054, illus., table, 1969.

Normal long-chain alcohols were isolated from Recent marine sediments from several environments. The isoprenoid alcohol dihydrophytol, which is thought to originate from phytol, the side chain of chlorophyll, by hydrogenation in the reducing environment of the sediment, was also present in most of the samples. Both the normal and isoprenoid alcohols were found in the Green River shale (Eocene). Geochemical implications are considered.—Authors' abstract

02234 **Shannon, Spencer S., Jr.** Possible volcanic origin of epithermal silver ores within the Idaho batholith [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 71-72, 1969.

02168 **Sharma, Munna Lal; Uehara, Goro; Mann, J. Adin, Jr.** Thermodynamic properties of water adsorbed on dry soil surfaces: Soil Sci., v. 107, no. 2, p. 86-93, illus., 1969.

The thermodynamic properties of water adsorbed on soil surfaces are not the same as those of pure liquid water. The thermodynamic properties change and tend to approach those of pure liquid water as the quantity of water adsorbed on a soil surface increases. The water adsorbed on the Molokai soil was more disordered than the water adsorbed on the Wahiawa soil of Hawaii.—JWH

02235 **Sheehan, Peter M.** Upper Ordovician brachiopods from eastern Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 72-73, table, 1969.

Shepard, Anna O. *See* Christ, C. L. 02195

02200 **Sheppard, Richard A.; Gude, Arthur J., 3d.** Rhodesite from Trinity County, California: Am. Mineralogist, v. 54, nos. 1-2, p. 251-255, illus., tables, 1969.

Rhodesite occurs as aggregates of radiating white, silky fibers associated with magadiite and trioctahedral montmorillonite in an altered silicic lava. Indices of refraction are $\alpha = 1.501 \pm 0.001$ and $\gamma = 1.513 \pm 0.001$. A least-squares refinement of X-ray diffractometer powder data resulted in orthorhombic cell dimensions of $a = 23.636 \pm 0.004$ A, $b = 6.549 \pm 0.001$ A, $c = 7.037 \pm 0.001$ A, and $V = 1089.3 \pm 0.3$ A^3. Chemical analysis yielded the formula: $Ca_{4.23}Mg_{0.27}Na_{0.60}K_{1.95}Si_{17.11}O_{40} \times 10.94$ H_2O.—Authors' abstract

02493 **Sheriff, R. E.** Addendum to glossary of terms used in geophysical exploration: Geophysics, v. 34, no. 2, p. 255-270, illus., 1969.

This is a supplement to the glossary of terms used in geophysical exploration, published in the February 1968 issue of Geophysics. The supplement contains many new terms related to mining geophysics as well as revisions of some previous entries—KAF

07533 **Shock, Robert N.; Katz, Samuel.** Pressure dependence of the infrared absorption of calcite: Am. Mineralogist, v. 53, nos. 11-12, p. 1910-1917, illus., 1968.

The infrared absorption of calcite has been measured to over 20 kbar at 25°C in a Bridgman diamond-anvil squeezer, an apparatus in which intense shear produces large specimen deformation. Although observed changes in the absorption spectrum with increasing pressure near 4 kbar strongly suggest the calcite-aragonite transformation, neither optical study in-situ nor X-ray analysis on unloading confirms this interpretation. The observed changes may result from a minor structural distortion which is aided by shear stresses and related to the calcite-aragonite transformation. —*from* Authors' abstract

02236 **Shoemaker, E. M.; Stephens, H. G.** The Green and Colorado River Canyons observed from the footsteps of Beaman and Hillers 97 years after Powell [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 73, 1969.

02277 **Shows, Thad N.** Water resources of Copiah County, *in* Copiah County geology and mineral resources: Mississippi Geol., Econ. and Topog. Survey Bull. 110, p. 63-109, illus., tables, 1969.

Copiah County is underlain by aquifers containing an abundance of ground water that requires a minimum of treatment for most uses; all municipal and industrial supplies are from wells with pumpage estimated at 8 mgd. Aquifers are unconsolidated deposits of sand and gravel—Eocene Kosciusko Formation to Holocene alluvium. Fresh water is available to a depth of more than 2,400 feet; the majority of wells are less than 600 feet deep and yield up to 300-400 gpm. The shallow Pleistocene Citronelle Formation and the Miocene Hattiesburg and Catahoula Formations offer the greatest potential for development. Generally aquifers dip to the southwest at about 40 feet per mile. In areas of heavy pumpage water levels are declining at a rate of 1-1 1/2 feet per year.—*from* Author's abstract

Shropshire, K. L. *See* Poole, F. G. 02247

Siems, Peter L. *See* Juras, Dwight S. 02136

07692 **Simonett, David S.** Potential of radar remote sensors as tools in reconnaissance geomorphic, vegetation and soil mapping [with French and German summ.], *in* Internat. Cong. Soil Sci., 9th, Adelaide, Australia, 1968, Trans., V. 4: New York, American Elsevier Publishing Co., p. 271-280, illus., 1968.

Nonphotographic remote sensors, particularly infrared and radar, used in concert with photography, may improve efficiency of ground reconnaissance in remote, difficult-of-access and under-developed areas in tropical and arctic latitudes. Focus here is on side-looking radar as a tool for such reconnaissance; its usefulness needs careful evaluation, since radar imagery may be obtained in swaths up to 40 miles wide, largely independent of the weather. A review is given of recent studies with radar on: mapping of lineaments and lithologic units, and its use as a surrogate for 1:24,000 scale maps in hydrologic analysis; mapping of vegetation types, especially in relation to structure; and its successes and shortcomings as an adjunct to photographs in soil reconnaissance. [Examples in California, Oklahoma and Oregon are cited.]—*from* Author's summary

Simons, D. B. *See* Stringham, G. E. 02261

Simons, P. Y. *See* Dachille, Frank. 07534

Simper, A. D., Jr. *See* Tidwell, William D. 02147

07517 **Simpson, Dale R.** Substitution in apatite—[Pt.] 2, Low temperature fluoride-hydroxyl apatite: Am. Mineralogist, v. 53, nos. 11-12, p. 1953-1964, illus., tables, 1968.

Analyses and cell dimensions are presented for apatites synthesized at 100° and 25°C in a variety of solutions. Apatites synthesized at 100°C at pH 7.4-8.1 show an alkali concentration that increases with fluoride concentration, and have a low cation to anion ratio. In very basic solutions apatite has a high cation to anion ratio. Increasing F^- concentration reduces the *a* lattice parameter; increasing the cation to anion ratio increases *c*. Balanced structural formulas require the incorporation of water as H_3O^+, $H_4O_4^{4+}$, and $H_2O°$ in the calcium, phosphate, and hydroxyl site respectively. Some crystals also require a reduction of charge of the phosphate site, a requirement that can be satisfied by substitution of PO_3F^{2-} for PO_4^{3-}.—*from* Author's abstract

Singh, Shri K. *See* Kuo, John T. 02495

Siple, George E. *See* Colquhoun, D. J. 02356

Skelton, John. *See* Feder, G. L. 02340

02485 **Skinner, Brian J.** First Penrose Conference: Geotimes, v. 14, no. 3, p. 15-16, 1969.

In at least 25 exploited porphyry deposits of copper and related molybdenum, a wealth of information flows from new discoveries and exploration below blankets of secondary enrichment, without recourse to masses of experimental data bearing on origin and location. This was the subject of G.S.A.'s first Penrose Conference, in January 1969 at Tucson, Ariz., limited to 70 geologists balanced between field and

experimental experts. Not many totally new concepts were announced, but each conferee learned much that was new to him. Controversial points on intrusions and mineralization were repeatedly discussed. Experimental reports were addressed more toward general than specific questions, due partly to paucity of reliable field data.—GDC

02266 **Skinner, William R.; Bowes, D. R.; Khoury, S. G.** Polyphase deformation in the Archean basement complex, Beartooth Mountains, Montana and Wyoming: Geol. Soc. America Bull., v. 80, no. 6, p. 1053-1060, illus., 1969.

Tectonic structures and related metamorphic mineral growths in the Archean crystalline rocks (*circa* 2.7 b.y.) of the Beartooth Mountains indicate an intense early phase of flow folding, followed by an episode of flexural-flow folding, followed in turn by at least two phases of flexural folding. The common granitic rocks of the region, the quartzo-feldspathic gneisses, developed early. Cross-cutting pegmatitic veins were emplaced after the flexural-flow folding and xenolith-bearing granite formed late. All these events are considered to have developed during a major orogenic episode, here named the *Beartooth orogeny*.—WHN

02296 **Škvor, Vladimir.** The Caribbean area—A case of destruction and regeneration of continent: Geol. Soc. America Bull., v. 80, no. 6, p. 961-968, illus., 1969.

The existence of the island arc of the Antilles, the verified differences between the Caribbean crust and the oceanic as well as the continental crust, and the Neoidic mobility lead to the assumption that a new part of the continent has been built here since Cretaceous times. Field evidence indicates that the metamorphosed basal complex of Cuba represents an entirely unconformable, probably Paleozoic continental structure, preserved relicts of which show that it was destroyed by partial "oceanization," through the intrusion of melted upper mantle material. The isostatic equilibrium was completely disturbed, and its stabilization gave rise to new movements, volcanism, and other effects, usually called the Neoidic orogeny, but more accurately termed the "regeneration of continent."—RAL

Slemmons, David B. *See* Glass, Charles E. 02132

02237 **Slemmons, David B.; McDonald, Robert L.; Cluff, Lloyd.** Surface faulting from the December 16, 1954, earthquake in Dixie Valley, Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 73-74, 1969.

Smith, Bennett L. *See* Vogel, Thomas A. 07572

Smith, D. K. *See* Borg, I. Y. 02193

Smith, D. K. *See* Borg, I. Y. 07540

02238 **Smith, Donald L.** An analysis of flank sediments from a Bermuda patch reef [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 74, 1969.

Smith, Gordon S. *See* Johnson, Quintin. 02369

02239 **Smith, Hugh P.** The Moenkopi Group of north-central Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 74-75, 1969.

Smith, P. F. *See* Esler, J. E. 07586

Smith, R. L. *See* Bailey, R. A. 02515

02144 **Smith, Robert B.** A sub-bottom seismic profile from Promontory Point to Lakeside, Great Salt Lake, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 75, 1969.

07635 **Smith, Ward C.** Borax solution at Kramer, California: Econ. Geology, v. 63, no. 8, p. 877-883, illus., 1968.

Material of obscure structure that forms part of the hanging wall of the great sodium borate ore body at Kramer, Calif., is interpreted as collapsed insoluble claystone layers left where interbedded borax has been dissolved. Nodular ulexite in such collapsed material is secondary; relationships between primary borax and contemporaneous ulexite or other syngenetic borate minerals remain unestablished. The effects of solution also leave unestablished the original limits of borax deposition. It is suggested that collapsed claystone layers containing ulexite might be used as an indicator of proximity to borax elsewhere in the district.—*from* Author's abstract

02221 **Smith, Wilbur H.** Geology of the Bingham mining district [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 75-76, 1969.

Smyth, Joseph R. *See* Moore, Paul B. 07543

02429 **Snavely, Parke D., Jr.; MacLeod, Norman S.** Local centers of Miocene volcanism along coastal Oregon and Washington [abs.]: Northwest Sci., v. 43, no. 1, p. 43, 1969.

02526 **Snelgrove, A. K.** Geological engineering attains status in 1968: Mining Eng., v. 21, no. 2, p. 80-86, table, 1969.

For the first time papers and field trips emphasizing engineering geology were scheduled at the XXIII International Geological Congress in 1968. Congress papers, which ranged over a wide variety of subjects and were contributed by participants from many countries, are summarized. In addition, selected U.S. projects reviewed show engineering geology applications to tunneling, land subsidence and stabilization, geologic hazards, regional and urban planning, site evaluation, rock mechanics, salt-water invasion, nuclear explosions, remote sensing, and geohydrology.—MAC

07552 **Snetsinger, Kenneth G.; Bunch, T. E.; Keil, Klaus.** Electron microprobe analysis of vanadium in the presence of titanium: Am. Mineralogist, v. 53, nos. 9-10, p. 1770-1773, tables, 1968.

A procedure is described for elimination $TiK_{\beta 1,3}$ overlap for accurate analysis of vanadium in the presence of titanium.—VSN

02439 **Snyder, John L.** Why major in geology?—Students answer: Geotimes, v. 14, no. 4, p. 13-14, 1969.

In reply to questionnaires of the American Geological Institute, distributed in 400 geology departments in the United States and Canada, to students intending to major in one of the geological sciences, more than 1,200 questionnaires were returned. Results show that college geology courses or teachers influence more students than any other single thing. Next most important is geology as a hobby, the interest aroused largely in elementary grades. Intention of going on for a graduate degree was expressed by 4 of 5 new majors. Areas of interest categorized are of minor importance; typical comments are quoted.—GDC

02222 **Sorbe, Victor K.** Aggregate serviceability study [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 76, 1969.

Southard, Alvin R. *See* Williams, J. Stewart. 02215

02223 **Southard, Alvin R.; Williams, J. Stewart.** An explanation of stony earth movement on the Franklin Ramp, Preston quadrangle, Idaho [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 77, 1969.

02501 **Spencer, Derek W.; Brewer, Peter G.** The distribution of copper, zinc and nickel in sea water of the Gulf of Maine and the Sargasso Sea: Geochim. et Cosmochim. Acta, v. 33, no. 3, p. 325-339, illus., tables, 1969.

During 6 cruises to the Gulf of Maine and the Sargasso Sea, water samples were collected and analyzed for Cu, Zn, and Ni. The results, taken over a period of 12 months, failed to reveal significant seasonal variations in the surface that could be at

tributed to biological removal. However, the Atlantic Slope water and the waters of the Sargasso Sea and Gulf Stream appear to maintain distinctly different concentrations of these metals, and several profiles show significant increases of nickel and zinc with depth. The data indicate that either the rate of uptake of the metals by organisms is low or the rate of regeneration of the metals in the surface is high. Despite the lack of observable seasonal variation, these elements do appear to be non-conservative properties of sea water.—*from* Authors' abstract

Sprinkle, James. *See* Robison, Richard A. 02230

02190 **Spry, A.; Turner, R. G.; Tobin, R. C.** Optical phenomena associated with Brazil-twin boundaries in quartz: Am. Mineralogist, v. 54, nos. 1-2, p. 117-133, illus., 1969.

Brazil-twin (left-handed to right-handed) boundaries in quartz when viewed between crossed polarizers under the microscope are marked by dark fringes. Complexities due to undulations on the twin boundary, to multiple parallel and intersecting twin boundaries and to tilting of the section may be recognized. The fringes are the result of optical activity and arise from the interference of elliptically polarized *ordinary* and *extraordinary* waves. Fringes are visible in thick sections but become more difficult to observe as the thickness is reduced; in petrographic thin sections (0.03 mm), those due to single and multiple boundaries are visible but those due to tilting are not.—Authors' abstract

Stafsudd, O. M. *See* Gentile, A. L. 07582

Stanley, A. *See* Henoch, W. E. 07671

Stanley, A. *See* Henoch, W. E. 07672

Stanley, A. *See* Henoch, W. E. 07673

Stanley, A. *See* Henoch, W. E. 07674

07659 **Stanley, Daniel J.; Swift, Donald J. P.** Bermuda's reef-front platform—Bathymetry and significance: Marine Geology, v. 6, no. 6, p. 479-500, illus., 1968.

Bermuda has a broad shallow submerged platform, 0.5 to over 3 nautical miles seaward of an elliptical reef tract. On this is a wide upper terrace at about 10 fathoms; a ridge at about 8 fathoms, locally at the outer edge of the upper terrace; and a sediment-covered narrow lower terrace at about 35 fathoms. Exploration suggests that the upper terrace is a relict feature cut prior to Holocene rise of sea level. The outer ridge may be a relict composed of aeolinite or may be coral reef growth during a warmer period, possibly the post-glacial thermal maximum. The lower terrace developed in the upper Bermuda pedestal during a lower still stand and was covered subsequently by a prograding sediment wedge. Its equal depth around the outer platform precludes tilting or faulting but not settling of the volcanic neck. —*from* Authors' abstract

07515 **Stanley, Kirk W.** Effects of the Alaska earthquake of March 27, 1964 on shore processes and beach morphology: U.S. Geol. Survey Prof. Paper 543-J, p. J1-J21, illus., 1968.

Some 10,000 miles of shoreline in southeastern Alaska was affected by subsidence or uplift associated with the earthquake of March 27, 1964. In areas of subsidence, beaches flattened in gradient and receded shoreward. Minor features were altered or destroyed but began to reappear and to stabilize within a few months after the earthquake. Frontal beach ridges migrated shoreward and grew in size. Vigorous erosion occurred on narrow beaches. Stream mouths were drowned but adjusted to the new conditions within a few months. In uplifted areas beaches were stranded out of reach of the sea. New beaches are developing to fit new sea levels. Streams were lengthened and downcutting and bank erosion have increased. Brief discussions of the effects on ecology and property values are included.—*from* Author's abstract

07637 **Stanton, R. L.; Gorman, Helen.** A phenomenological study of grain boundary migration in some common sulfides: Econ. Geology, v. 63, no. 8, p. 907-923, illus., tables, 1968.

Heating experiments show that natural deformed aggregates of sulfides (galena, sphalerite, chalcopyrite) anneal at rates that increase with temperature. The actual rates are affected by preferred orientation, included impurities, and possibly anisotropism. "Two-phase aggregates also anneal and, for galena and sphalerite at least, the dihedral angle [angle developed by a crystal of one sulfide at its triple junction point with two grains of the other] decreases with increase in temperature." The geologically very short time required for annealing at low temperature raises questions for interpretation of deformation textures.—WSW

02362 **State Geologists Journal.** In memoriam—Wilbur Armistead Nelson, 1890-1969: State Geologists Jour., v. 21, no. 1, p. 30-31, 1969.

02224 **Steidtmann, James R.** Origin of the early Eocene Pass Peak Formation, central-western Wyoming [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 77-78, 1969.

07658 **Steinbrugge, Karl V.** Earthquake hazard in the San Francisco Bay area—A continuing problem in public policy: Berkeley, Calif., California Univ. Inst. Governmental Studies, 80 p., illus., tables, 1968.

This monograph is primarily directed towards an understanding of the local earthquake hazard in the San Francisco Bay area so that public policy can be better formulated to respond to the danger. Steps that should be taken in pre-earthquake planning to assure maximum feasible protection against life hazard, and reduction of potential property damage to optimum levels are discussed. The text is in three sections: frequency of damaging Bay area earthquakes, geologic hazards (such as active faults, structurally poor ground, and earthquake-induced landslides), and expected earthquake performance of existing and new buildings and other structures.—VSN

Stephens, H. G. *See* Shoemaker, E. M. 02236

02225 **Stevens, Calvin H.** Middle to Late Triassic deformation in the Inyo, White and northern Argus Mountains, California [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 78, 1969.

Stevens, J. G. *See* Bowen, L. H. 02186

02343 **Stevenson, I. M.** Lac Brulé and Winokapau Lake map-areas, Newfoundland and Quebec (13D, 13E): Canada Geol. Survey Paper 67-69, 16 p., geol. maps, 1969.

Precambrian rocks of these areas are typical Grenville gneisses; gabbroic intrusives grade into anorthosite and coarse-grained granitic masses are probably intrusive. Metasedimentary and metavolcanic outcrops in the northern area are believed to be Proterozoic, a southern extension of the Seal Lake Group. Much younger, relatively unmetamorphosed clastics outcrop on Lake Michikamau islands. Following no apparent regional pattern, the metamorphic facies range from greenschist to granulite. Structure, from several deformations, is too complex for detail on present map scale. Foliation dips in gneisses are steep to overturned; abundant evidence of faulting is obscured by heavy drift and forest cover. Parallel faults, striking northeast between Red Wine Mts. and Lake Michikamau may mark the Grenville Front.—GDC

02226 **Stewart, John H.** Systematic pattern of tensional failure producing Basin and Range structure in Nevada and Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 78-79, 1969.

Stone, Charles G. *See* Gordon, Mackenzie, Jr. 02403

02383 **Stott, D. F.** Ellef Ringnes Island, Canadian Arctic Archipelago: Canada Geol. Survey Paper 68-16, 44 p., table, geol. map, 1969.

Ellef Ringnes Island [Northwest Territories] has broad lowlands and locally dissected uplands, reflecting the diverse structure and lithology of the bedrock, rimmed by low coastal shelves, and dotted with domal structures of diapiric anhydrite and secondary gypsum. The Sverdrup basin includes most of the island and a great thickness of marine sediments; eleven formations, early Carboniferous to early Tertiary in age, are described in ascending order. These are deformed into broad, shallow folds trending north to northwest; normal faults trend northeast in the northern part of the island, where basic dikes and sills extensively intrude the Deer Bay Formation. Beneath the Arctic Coastal Plain the nonmarine, clastic Beaufort Formation dips gently northwest, unconformable on the deformed beds of the basin. In the diapirs, at culminations of major anticlines, are excellent possibilities for oil and gas accumulation.—GDC

07688 **Stow, Stephen H.** The heavy minerals of the Bone Valley Formation and their potential value: Econ. Geology, v. 63, no. 8, p. 973-975, tables, 1968.

Although heavy-mineral content of the Bone Valley is small (0.23 percent in matrix zone), the large volume of rock mined and treated for phosphate makes the potential production large. Potential value of ilmenite, zircon, and monazite discarded in 1967 in flotation waste is as much as 5,000,000 dollars. Other minerals in the waste include staurolite, garnet, kyanite, sillimanite, tourmaline, epidote, and spinel.—WSW

Stradley, A. C. *See* Bailey, R. L. 02122

Strangway, D. *See* Larson, E. 02341

02261 **Stringham, G. E.; Simons, D. B.; Guy, H. P.** The behavior of large particles falling in quiescent liquids: U.S. Geol. Survey Prof. Paper 562-C, p. C1-C36, illus., tables, 1969.

The free-fall behavior of particles falling singly into quiescent liquids was observed with respect to fall patterns, velocity, and travel path. Particle shapes and densities were chosen to represent limiting conditions of gravel-sized sediment in alluvial channels. Spheres fell in a straight vertical path while discs exhibited four types of behavior. Steadiness of the particle is dependent upon stability of the resultant of pressure forces in the particle wake; shape and Reynolds number affect distribution of pressure forces in the wake. The ratio of path length to vertical distance through which the particle falls is related to particle steadiness. The effect of particle-fluid density ratio and thickness-diameter ratio on fall velocity and steadiness can be expressed by a dimensionless stability number; frequency of oscillation can be related to fall velocity and particle diameter by a dimensionless frequency number.—*from* Authors' abstract

Strohmeier, M. T. *See* Cook, Kenneth L. 02113

02481 **Stueber, Alan M.** Abundances of K, Rb, Sr and Sr isotopes in ultramafic rocks and minerals from western North Carolina: Geochim. et Cosmochim. Acta, v. 33, no. 5, p. 543-553, illus., table, 1969.

Detailed study of the Sr isotopic composition of closely associated alpine-type ultramafic intrusions in western North Carolina has revealed variable but high Sr-87/Sr-86 ratios. Radiogenic Sr seems to be present in the primary silicate minerals, which in most cases have suffered little or no visible alteration. This radiogenic Sr may be of secondary origin, having been introduced, perhaps, during a regional metamorphism about 350 m.y. ago. Concentrations of K, Rb, and particularly Sr in the ultramafic rocks are related to the amount of diopside present. The absolute abundance levels of all 3 elements are generally higher in minerals separated from a basaltic ultramafic nodule than in those separated from alpine-type intrusions.—KAF

07559 **Stumpfl, E. F.; Rucklidge, J.** New data on natural phases in the system Ag-Te: Am. Mineralogist, v. 53, nos. 9-10, p. 1513-1522, illus., tables, 1968.

Natural samples of hessite, empressite, and stutzite were examined under electron probe and found to have composition consistent with formula ratios of Ag:Te of 2:1, 1:1, and 5-x:3 where x ranges from 0.24 to 0.36 respectively.—JLH

Summers, Paul. *See* Williams, J. Stewart. 02215

02227 **Summers, W. K.** Geologic survey of thermal ground waters in New Mexico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 79, 1969.

02228 **Sumsion, Carlton T.** Ground water occurrence in the Spanish Valley area, Grand and San Juan Counties, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 79-80, 1969.

02201 **Surdam, Ronald C.** Electron microprobe study of prehnite and pumpellyite from the Karmutsen Group, Vancouver Island, British Columbia: Am. Mineralogist, v. 54, nos. 1-2, p. 256-266, illus., tables, 1969.

Prehnite and pumpellyite are abundant low-grade metamorphic minerals in the Triassic metavolcanic rocks. They occur as amygdaloidal minerals and alteration products of glass and plagioclase. Prehnite from the Karmutsen Group shows appreciable solid solution between the ideal end members $Ca_2Al_2Si_3O_{10}(OH)_2$ and $Ca_2Fe_2Si_3O_{10}(OH)_2$; at least 30 mole percent of the latter is present in some samples. The average total Fe as Fe_2O_3 content of 18 samples ranges from less than 0.1 to 8.2 percent. Pumpellyite also shows a wide range of total iron compositions. The inverse relation between Fe and Al indicates that much of the iron is Fe^{3+}. Maximum determined total iron is 23.0 percent expressed as Fe_2O_3. The compositional field of pumpellyite is expanded at low temperatures and pressures.—*from* Author's abstract

07641 **Surdam, Ronald C.** Origin of native copper and hematite in the Karmutsen Group, Vancouver Island, British Columbia: Econ. Geology, v. 63, no. 8, p. 961-966, illus., 1968.

Native copper occurs as blebs in prehnite in parts of the 17,500-ft Karmutsen Group that are characterized by thin, reddish, very amygdular, nonpillowed mafic flows. It occurs where the primary iron-titanium oxides were altered to hematite during lava cooling by reaction with hot magmatic gases enriched in oxygen through fractionation or contamination. Chalcopyrite is the copper mineral in rocks with little or no hematite. It is suggested that the native copper was formed during low-grade metamorphism by an oxidation reaction involving hematite and chalcopyrite. —WSW

02229 **Suttner, Lee J.; Schwartz, Robert K.** Petrographic vertical profile study of a barrier island-marine shelf sandstone complex [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 80, 1969.

02145 **Sutton, R. L.; Hendricks, J. D.; Ackermann, H. D.** Geology and geophysics of Shonto diatreme, Hopi Buttes volcanic field, Navajo County, Arizona [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 80-81, 1969.

Swift, Donald J. P. *See* Stanley, Daniel J. 07659

Swindale, L. D. *See* Loganathan, P. 02571

Swineford, Ada. *See* Jewett, John Mark. 07665

Syers, J. K. *See* Chapman, S. L. 02299

07602 **Sykes, C. Ronald.** Mineral resources summary of the Rose Creek quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 3 p., 1968.

This summary accompanies Tennessee Div. Geology Geol. Map GM 4-NW by W. S. Parks (cited separately). No mining is known to have been done in the Rose Creek quadrangle, but potential resources are sand, heavy minerals, and chemical earth. —MCM

07604 **Sykes, C. Ronald.** Mineral resources summary of the Masseyville quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 4 p., 1968.

Sand, the only mined resource in the Masseyville quadrangle, is abundant in the generally loosely consolidated sediments; mining has been from the Claiborne and Wilcox Formations for road use. Potential resources are clay and heavy minerals. This text accompanies Tennessee Div. Geology Geol. Map GM 12A-SW by D. L. Brown (cited separately).—MCM

07605 **Sykes, C. Ronald.** Mineral resources summary of the Henderson quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 7 p., illus., 1968.

Sand, the only resource mined in the Henderson quadrangle, is abundant in the unconsolidated sediments of the Clayton, McNairy, and Claiborne Formations. Clay and heavy minerals are potential resources. This summary accompanies Tennessee Div. Geology Geol. Map GM 12A-NW by D. L. Brown (cited separately).—MCM

07610 **Sykes, C. Ronald.** Mineral resources summary of the Medon quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 6 p., 1968.

Mined mineral resources in the Medon quadrangle are sand from the Claiborne Formation and from fluvial deposits, and clay from the Wilcox Formation. This text accompanies Tennessee Div. Geology Geol. Map GM 439-NE by W. S. Parks (cited separately).—MCM

07611 **Sykes, C. Ronald.** Mineral resources summary of the Beech Bluff quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 5 p., 1968.

Sand is abundant in the generally unconsolidated sediments underlying Beech Bluff quadrangle; all mapped units contain some sand, but only that in the Claiborne Formation has been mined. Potential resources are clay and heavy minerals. This summary accompanies Tennessee Div. Geology Geol. Map GM 446-SW by W. S. Parks (cited separately).—MCM

07612 **Sykes, C. Ronald.** Mineral resources summary of the Luray quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 2 p., 1968.

No mining has been done in the Luray quadrangle; potential resources are sand and heavy minerals. This summary accompanies Tennessee Div. Geology Geol. Map GM 446-SE by D. L. Brown (cited separately).—MCM

Sykes, Lynn R. *See* Isacks, Bryan. 02538

02389 **Symons, D. T. A.** Geological implications of paleomagnetic studies in the Bella Coola and Laredo Sound map-areas, British Columbia (93D and 103A): Canada Geol. Survey Paper 68-72, 15 p., illus., tables, 1969.

A complex of granitic plutons with few time-markers underlies the Coast Mountains. Paleomagnetism of 533 specimens from 70 sites representing several basic igneous units was studied to assess their value as time-markers. Thirty-one sites yielded remanence data that confirm and in part refine the time-scale established for the map-areas by reconnaissance mapping. The late Paleozoic or early Mesozoic greenstone complex and Tertiary blue porphyrytic dikes proved unsuitable for paleomagnetic study. Jurassic gabbroic plutons, Cretaceous gabbroic dikes, Paleocene or Eocene granodiorite intrusives, late Miocene or early Pliocene basalt flows, and late Miocene to Pleistocene brown basaltic dikes have a primary TRM acquired during intrusion. The Mesozoic greenstone dikes acquired a secondary TRM during late stages of Cretaceous-Paleocene orogeny.—GDC

02430 **Taubeneck, William H.** Feeder dikes for Columbia River basalt in northeastern Oregon, western Idaho, and southeastern Washington [abs.]: Northwest Sci., v. 43, no. 1, p. 43, 1969.

07702 **Taugourdeau, Ph.** Sur un assemblage partiel (Scolécodontes) de *Polychetaspis oklahomensis* n. sp.: Rev. Micropaléontologie, v. 11, no. 3, p. 176-180, illus., 1968.

A partial natural scolecodont assemblage (polychaete annelid jaw apparatus) was found in a sample of "*Isotelus*" limestone of Blackriverian (Middle Ordovician) age, from the Criner Hills, Okla. The overlapping, displaced parts were separated after acid treatment of the limestone and were slide-mounted for study; the parts are two carrier plates, one basal plate, with an associated intercalary denticle, and one maxilla 1 (forceps). The plates were reoriented and restoration of some missing parts was made, by comparison with European and other North American specimens. The assemblage is assigned to *Polychetaspis* Kozlowski 1956, a genus based on several natural assemblages from Poland; disjunct specimens (isolated plates) were previously known outside of Europe under form-generic names.—VMJ

02165 **Taylor, A. W.** The selectivity coefficient of slowly exchangeable calcium and strontium: Soil Sci., v. 107, no. 1, p. 58-62, 1969.

The slow approach to isotopic equilibrium shown by exchangeable strontium in some acid soils of the North Carolina coastal plain is also exhibited by the exchangeable calcium. The exchange equilibrium between these ions may not be reached in less than one month. The slow exchange has no practical significance for the separation of calcium and strontium.—JWH

07565 **Taylor, Alan W.** Strontium retention in acid soils of the North Carolina plain: Soil Sci., v. 106, no. 6, p. 440-447, illus., tables, 1968.

When trace quantities of radiostrontium are equilibrated with some acid soils for periods of 40 days, significant amounts cannot be recovered in rapid extraction with normal solutions of strontium nitrate. Isotropic equilibrium is approached only when the extraction is extended over a time equal to that taken for the original labeling. The mechanism of occlusion of this strontium is not a permanent fixation, but is due to the slow exchange reaction of the soil. The same reaction is probably shown by calcium ions.—JWH

Taylor, D. *See* Pirie, E. 07563

07571 **Taylor, D.; Henderson, C. M. B.** The thermal expansion of the leucite group of minerals: Am. Mineralogist, v. 53, nos. 9-10, p. 1476-1489, illus., tables, 1968.

Thermal expansion data up to 920°C, obtained by X-ray powder diffraction methods, are presented for a natural leucite and synthetic K-leucite, Rb-leucite, and Cs-leucite (pollucite). The first three minerals are tetragonal at 25°C and invert to cubic symmetry at temperatures of 690°, 605°, and 310°C respectively; Cs-leucite is cubic at 25°C. The volume thermal expansion of synthetic K-leucite and Rb-leucite shows three stages distinguished by their different rates of expansion. The first and second stages have high expansion rates whereas the third stage has a much lower expansion rate. Cs-leucite shows only the second and third stages and natural leucite included in this study shows only the first and third stages.—*from* Authors' abstract

02531 **Taylor, I. R.** Union Carbide's twin-pit vanadium venture at Wilson Springs: Mining Eng., v. 21, no. 4, p. 82-85, illus., table, 1969.

Pipe-like vanadium ore bodies are found about six miles from the Magnet Cove district, Ark., in the highly argillized and metamorphosed contact zone between an igneous intrusion and the disturbed sedimentary rocks which surround it. The vanadium ore bodies, made up of vanadiferous clays and minor montroseite, occur mainly in the hydrothermal clays to depths of 200 to 400 feet.—MAC

Taylor, Landon C. *See* Wilson, Charles W., Jr. 07609

02146 **Taylor, Michael E.** Biostratigraphy and environments of Upper Cambrian (Upper Franconian-Trempealeauan) strata in the central Great Basin, Utah and Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 81, 1969.

Terasmae, J. *See* Hobson, George D. 02388

02220 **Terrell, Forrest M.** Silicified trilobite zonation in the lower Fillmore Formation in western Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 82, 1969.

07642 **Thomas, Chester E., Jr.; Cervione, Michael A., Jr.; Grossman, I. G.** Water resources inventory of Connecticut—Pt. 3, Lower Thames and southeastern coastal river basins: Connecticut Water Resources Bull. 15, 105 p., illus., tables, 1968.

These basins near New London have abundant surface water, and ground-water underflow. Stream flow varies from point to point with proportion of stratified drift; ground water is available from wells almost anywhere. Stratified drift, covering 20 percent of the area, can yield more than 100 gpm; permeability per sq ft of coarse-grained drift averages 1,500 gpd, of fine-grained 300 gpd. Bedrock and till provide only small supplies. Water quality is good to excellent. Hardness of stream water rarely exceeds 60 ppm; ground water 120 ppm. Temperature of ground water at depth below 30 feet is a fairly constant 48° to 55°F; in shallow wells it fluctuates seasonally between 38° and 55°F; stream water ranges between 32° and 85°F.—GDC

02339 **Thompson, Gerald L.** Ground-water resources of Johnson County, Texas: Texas Water Devel. Board Rept. 94, 84 p., illus., tables, 1969.

Annual rainfall in Johnson County is sufficient to sustain extensive agricultural development; part of the water for public supply and industrial uses in the central part is surface water from recently constructed reservoirs. Use of ground water for irrigation is limited by low yield of most wells and high sodium content. Principal aquifers and approximate quantity in acre-feet of water supplied in 1966 are: Hosston Formation, 580; Travis Peak Formation, 360; Paluxy Sand, 2,000; Woodbine Formation, 680; and a small quantity from Quaternary alluvial deposits. About half the water now being withdrawn from the Paluxy comes from storage; the Paluxy transmits about 1,000 acre-feet per year less than the quantity currently being pumped. In 1966 pumpage from the Woodbine was less than half the amount transmitted; over 2 million acre-feet are available from storage in the eastern part.—*from* Author's abstract

07519 **Thompson, J. B., Jr.; Waldbaum, D. R.** Mixing properties of sanidine crystalline solutions—[Pt.] 1, Calculations based on ion-exchange data: Am. Mineralogist, v. 53, nos. 11-12, p. 1965-1999, illus., tables, 1968.

A statistical analysis of the ion-exchange data for highly disordered alkali feldspars shows that the Gibbs energy of mixing of these feldspars can be represented satisfactorily by an asymmetric Margules equation containing only two empirical parameters at a given temperature and pressure. Data indicate that at 650°C and 2 kbar the excess Gibbs energy of mixing for monoclinic alkali feldspar is very nearly: $\overline{G}_{ex} = 4.20\ N_{Or}N^2_{Ab} + 2.95\ N_{Ab}N^2_{Or}$ kcal mole^{-1}. The temperature range of the data is too limited to permit satisfactory determination of the temperature dependence of the mixing parameters.—*from* Authors' abstract

Thompson, J. B., Jr. *See* Waldbaum, D. R. 07520

07639 **Thompson, Tommy B.** Hydrothermal alteration and mineralization of the Rialto stock, Lincoln County, New Mexico: Econ. Geology, v. 63, no. 8, p. 943-949, illus., tables, 1968.

Zones of hydrothermal alteration lie within and surround an area containing eight breccia pipes in a hornblende-biotite monzonite stock. Alteration (pervasive quartz-sericite) is most intense adjacent to the breccia pipes. The outer boundary of an extensive area of argillized monzonite encloses the area of the pipes and marks the inner boundary of an outer propylitic zone. Magnetite-sphene veinlets in the propylitic zone represent constituents leached from the inner zone. The mineralization of a central molybdenite zone and surrounding copper zone is close to or within the breccia pipes. Zinc-lead ratios decrease with distance from the stock.—WSW

Thurston, J. F. *See* Bennett, G. 02305

Thurston, P. *See* Bennett, G. 02319

Thurston, P. C. *See* Bennett, G. 02304

Thurston, P. C. *See* Bennett, G. 02305

02292 **Tibbetts, B. L.; Behrendt, J. C.; Love, J. D.** Seismic-refraction measurements in Jackson Hole, Wyoming: Geol. Soc. America Bull., v. 80, no. 6, p. 1109-1121, illus., table, 1969.

Three reversed seismic-refraction profiles show that the maximum thickness in Jackson Hole of sediments and sedimentary rocks down to the crystalline Precambrian basement is 5 km, and that the minimum throw of the Teton fault is 7 km in the area covered by this survey.—AG

Tibbetts, Benton L. *See* Behrendt, John C. 07532

02216 **Tidwell, W. D.; Rushforth, S. R.; Reveal, J. L.; Behunin, H.** Petrified palm wood from the Arapien Shale (Jurassic) of Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 82-83, 1969.

02147 **Tidwell, William D.; Rushforth, Samuel R.; Simper, A. D., Jr.** Lepidodendrales from the Manning Canyon Shale Formation, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 82, 1969.

Tilling, R. I. *See* Doe, B. R. 07636

02348 **Timur, A.** Producible porosity and permeability of sandstones investigated through nuclear magnetic resonance principles: Log Analyst, v. 10, no. 1, p. 3-11, illus., tables, 1969.

Laboratory measurements of porosity, permeability, residual water saturation, free fluid index, and spin-lattice relaxation time, on more than 150 sandstone samples from Gulf Coast, California, and Colorado oil fields, indicate that the nuclear magnetic log can be interpreted in terms of producible porosity and permeability in sandstone sections, provided well-logging measurements are obtainable. Almost direct correspondence between porosity and FFI is indicated for the well-consolidated Colorado samples, but larger scatter for the poorly consolidated Gulf Coast samples; for the moderately well-consolidated but poorly sorted California samples, quality or relationship is intermediate. Permeability can be estimated with a choice of in situ measurable parameters.—GDC

07632 **Ting, William S.** Fossil pollen grains of Coniferales from early Tertiary of Idaho, Nevada and Colorado: Pollen et Spores, v. 10, no. 3, p. 557-598, illus., tables, 1968.

Bi-saccate fossil pollen from Eocene deposits at Thunder Mountain, Idaho; the I. L. Formation, Nevada; and the Oligocene Florissant beds, Colorado, are described and illustrated. Pollen of gymnosperms, mainly mountain conifers, were dominant in all samples except Florissant. They reached 91.7 percent in the Thunder Mountain sample and averaged about 82 percent in I. L. Formation samples. The major components of the samples were *Picea*, *Abies*, *Pinus* and *Podocarpus*—KAF

02385 **Tipper, H. W.** Mesozoic and Cenozoic geology of the northeast part of Mount Waddington map-area (92N), Coast district, British Columbia: Canada Geol. Survey Paper 68-33, 103 p., illus., tables, geol. map, 1969.

The northeastern part of Mount Waddington map-area is underlain mainly by Upper Triassic to Tertiary volcanic and sedimentary rocks. The Upper Jurassic and Lower Cretaceous rocks were deposited in the northwest-trending Tyaughton Trough. Small stocks of granitic rocks were emplaced in post-Cenomanian time within the mapped part of the area and to the southwest. In Late Cretaceous or early Tertiary time the area was disrupted first by northeasterly directed thrust faults, later by repeated movement on northwest-trending, right-lateral transcurrent faults, and finally by northeast-trending normal faults.—Author's abstract

Tipper, H. W. *See* Armstrong, J. E. 02549

02550 **Tipper, H. W.** Geology, Anahim Lake, British Columbia: Canada Geol. Survey Map 1202A, scale 1:253,440, text, 1969.

In the Anahim Lake area, bedrock is well exposed in the Coast Mountains, but elsewhere outcrops are scattered and drift-covered areas are extensive. Oldest rocks are lithologically similar to Upper Triassic or Lower Jurassic rocks north and south of the map-area. Overriding by Pleistocene ice and the complex mode of deglaciation has left a confusion of conflicting evidence and of many and varied glacial features. The great extent of flat-lying Tertiary rocks obscures the structural pattern of the pre-Tertiary rocks. Mesozoic volcanic and sedimentary rocks are undoubtedly folded but as rocks rarely outcrop, little is known of the nature of these folds. A prominent feature of the Coast Mts. is the abundance of steeply dipping faults. No mineral occurrence of any size or importance is known.—MCM

Tobin, R. C. *See* Spry, A. 02190

Todd, S. G. *See* Bailey, R. L. 02122

Tomanek, G. W. *See* Glover, Robert K. 07684

Tooker, E. W. *See* Roberts, Ralph J. 02143

02217 **Tooker, E. W.; Roberts, R. J.** Thrust fault structures in the Stansbury Mountains, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 83, 1969.

Toomre, Alar. *See* Goldreich, Peter. 02503

Tourtelot, Elizabeth B. *See* Vine, James D. 02512

Treitel, Sven. *See* Wuenschel, P. O. 02499

02312 **Trowell, N. F.** Watcomb Clarkdon area (west and east halves), District of Kenora: Ontario Dept. Mines Prelim. Geol. Maps P. 524-525, scale 1 in. to 1/4 mi., text, 1969.

Trujillo-Candelaria, Antonio. *See* García-Calderón, Jorge. 07648

Turner, R. G. *See* Spry, A. 02190

Turner, R. L. *See* McCarthy, J. H., Jr. 02466

07575 **Tuttle, Sherwood D.; Prior, Stanley J., Jr.** Geomorphology in Iowa 1943-1968—An annotated bibliography of the literature: Iowa Acad. Sci. Proc. 1968, v. 75, p. 253-267, 1968.

A study of what has been written about the geomorphology of Iowa since the publication of the Kay volume, *The Pleistocene of Iowa* in 1943, resulted in the compilation of an annotated bibliography. An examination of the subject material and procedures described suggests: studies since 1943 are process oriented rather than time oriented; increased use of paleosols and buried erosion surfaces; introduction of radiocarbon dating; and a lack of discussion about a framework for geomorphology.—Authors' abstract

Uehara, Goro. *See* Sharma, Munna Lal. 02168

02153 **U.S. Geological Survey.** Aeromagnetic map of the Eastford quadrangle and part of the Hampton quadrangle, Tolland and Windham Counties, Connecticut: U.S. Geol. Survey Geophys. Inv. Map GP-651, scale 1:24,000, 1969.

02154 **U.S. Geological Survey.** Aeromagnetic map of the First Connecticut Lake and vicinity, northern New Hampshire: U.S. Geol. Survey Geophys. Inv. Map GP-654, scale 1:62,500, 1969.

02155 **U.S. Geological Survey.** Aeromagnetic map of the Williamsburg quadrangle and part of the Shelburne Falls quadrangle, Franklin and Hampshire Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-659, scale 1:24,000, 1969.

02156 **U.S. Geological Survey.** Aeromagnetic map of the Easthampton quadrangle, Hampshire and Hampden Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-661, scale 1:24,000, 1969.

02157 **U.S. Geological Survey.** Aeromagnetic map of the Mt. Holyoke quadrangle, Hampshire and Hampden Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-662, scale 1:24,000, 1969.

02158 **U.S. Geological Survey.** Aeromagnetic map of the Belchertown quadrangle, Hampshire County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-663, scale 1:24,000, 1969.

02159 **U.S. Geological Survey.** Aeromagnetic map of the Winsor Dam quadrangle, Hampshire, Worcester, and Franklin Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-664, scale 1:24,000, 1969.

02160 **U.S. Geological Survey.** Aeromagnetic map of the Ware quadrangle, Worcester, and Hampshire Counties, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-665, scale 1:24,000, 1969.

02161 **U.S. Geological Survey.** Aeromagnetic map of the North Brookfield quadrangle, Worcester County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-666, scale 1:24,000, 1969.

02162 **U.S. Geological Survey.** Aeromagnetic map of the Paxton quadrangle, Worcester County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-667, scale 1:24,000, 1969.

02163 **U.S. Geological Survey.** Aeromagnetic map of the Worcester North quadrangle, Worcester County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-668, scale 1:24,000, 1969.

02164 **U.S. Geological Survey.** Aeromagnetic map of the Custer-Rapid City area, southwestern South Dakota: U.S. Geol. Survey Geophys. Inv. Map GP-670, scale 1:62,500, 1969.

02465 **U.S. Geological Survey.** U.S. Geological Survey heavy metals program, progress report 1968—Field studies: U.S. Geol. Survey Circ. 621, 34 p., 1969.

The heavy metals program of the U.S. Geological Survey and the U.S. Bureau of Mines was begun in mid-1966. This report summarizes field studies carried out during 1968: geologic drilling; geophysical support; new facilities and equipment; publications; studies on land—Alaska, California, Colorado, Georgia, Maine, Massachusetts, Montana, Nevada, New Hampshire, New Mexico, North and South Carolina, South Dakota, Utah, Vermont, Virginia, and Wyoming; marine studies—near Alaska, Washington, Oregon, California, Middle Atlantic continental shelf; and silver content of Foraminifera-bearing deep ocean sediments.—MCM

02566 **U.S. Geological Survey.** U.S. Geological Survey heavy metals program progress report 1968—Topical studies: U.S. Geol. Survey Circ. 622, 19 p., 1969.

Summaries of topical studies carried out in calendar year 1968 as part of the Heavy Metals program are presented in this circular. Studies are grouped as follows: gold, other trace elements, and heavy minerals in sedimentary rocks; research in geochemistry, research in geophysics; and research on analytical methods. Miscellaneous studies include fluid inclusions, zoning, trace elements, platinum-group minerals, solubility, and transport.—MCM

02387 **Usik, Lily.** Review of geochemical and geobotanical prospecting methods in peatland: Canada Geol. Survey Paper 68-66, 43 p., 1969.

The literature on prospecting in peatlands is reviewed. Suggestions are made for further work on a detailed and regional scale using peatlands in geochemical and geobotanical surveys to outline mineral belts and locate mineral deposits. A comprehensive bibliography is included.—Authors' abstract

Valdes, Sylvia. *See* Lidz, Louis. 02363

02218 **Vallier, Tracy L.** Eugeosynclinal Permian rocks in the Snake River Canyon, northeastern Oregon and western Idaho [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 83-84, 1969.

VanAlstine, Ralph E. *See* Lipman, Peter W. 02204

Vand, Vladimir. *See* Keester, Kenneth L. 02180

02293 **vandeKamp, P. C.** Origin of amphibolites in the Beartooth Mountains, Wyoming and Montana—New data and interpretation: Geol. Soc. America Bull., v. 80, no. 6, p. 1127-1135, illus., tables, 1969.

Nine new amphibolite samples were analyzed by X-ray fluorescence using Philips PW 1212 X-ray spectrometer which was calibrated by comparing results on previously analyzed rocks and standard amphibolite. The abundance of major and minor elements—particularly rubidium-strontium and lanthanum-cerium ratios—in these rocks suggests that their progenitors were basic to intermediate igneous rocks rather than calcareous shales as has been assumed by previous investigators.—AH

02219 **VanDorston, Philip Lonn.** Environmental analysis of the Swan Peak Formation in the Bear River Range, north-central Utah and southern Idaho [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 84, 1969.

02370 **VanLieu, J. A.** Geologic map of the Four Corners quadrangle, Wyoming and South Dakota: U.S. Geol. Survey Misc. Geol. Inv. Map I-581, scale 1:48,000, 1969.

02484 **VanSchmus, W. R.; Ribbe, P. H.** Composition of phosphate minerals in ordinary chondrites: Geochim. et Cosmochim. Acta, v. 33, no. 5, p. 637-640, tables, 1969.

The compositions of chlorapatite and whitlockite from three representative ordinary chondrites determined with the electron microprobe are given. No definite differences in compositions of these minerals were noted between H and L, or L and LL group chondrites.—*from* Authors' abstract

02258 **VanValen, Leigh.** Evolution of dental growth and adaptation in mammalian carnivores: Evolution, v. 23, no. 1, p. 96-117, illus., 1969.

A relatively high degree of carnassiality (teeth specialized for vertical shearing) has evolved independently in at least seven groups of mammals: among the placentals, the Carnivora in the strict sense (from the Miacidae), some extinct erinaceid insectivores, the hyaenodontid and oxyaenid deltatheridians, and some mesonychid condylarths; among the marsupials, the borhyaenids, the advanced dasyurids, and perhaps the thylacoleonids. The action of carnassial dentitions is discussed in relation to growth, structure, and evolution of these groups. Graphic comparisons relate length and angle of the shear on different teeth, and tooth position, to phylogeny. The fact that larger carnivores usually have larger prey relative to their own body size accounts for the major dental differences between carnivores and insectivores.—VMJ

02259 **VanValen, Leigh.** The multiple origins of the placental carnivores: Evolution, v. 23, no. 1, p. 118-130, illus., 1969.

The order Carnivora, as usually constituted, is shown to be polyphyletic, although this is probably not true for extant members. The early Tertiary Mesonychidae and Arctocyonidae, formerly considered creodont carnivores, are shown to belong to Condylarthra, the basal order of ungulates. The Miacidae, basal family of the order Carnivora as here restricted, probably evolved from a pre-paleoryctid insectivore similar to the Late Cretaceous procerberine leptictid (or paleoryctid) *Procerberus*.

The Carnivora and the Deltatheridia may have a special relationship, as suggested by similarities between the Paleocene viverravine miacid *Ictidopappus* and the Late Cretaceous palaeocryctid *Cimolestes*. Ictidopappini, new tribe, is here proposed for *Ictidopappus*, and Mesonychia and Arctocyonia are new names for suborders of Condylarthra.—VMJ

Viertl, J. R. M. *See* Fleischer, R. L. 02448

02463 **Vine, F. J.** Sea-floor spreading—New evidence: Jour. Geol. Education, v. 17, no. 1, p. 6-16, illus., 1969.

This review of sea-floor spreading discusses the following topics: seismicity of the Earth, movement of crustal plates, transform faults, the magnetic record, rates and relative movements, the reversal time scale, extrapolation across the ocean basins, and the age of the ocean floor.—ESL

02512 **Vine, James D.; Tourtelot, Elizabeth B.; Keith, John R.** Element distribution in some trough and platform types of black shale and associated rocks: U.S. Geol. Survey Bull. 1214-H, p. H1-H38, illus., tables, 1969.

The distributions of chemical elements in four sample sets of black shale and associated rocks were examined statistically. Minor elements in samples of the Belden Shale of Pennsylvanian age from Colorado and in upper Paleozoic shales of the Ouachita geosyncline show little association with organic matter. High concentrations of barium in the Ouachita samples may have been authigenically redistributed. Samples of the Cherokee Group from the Western Interior coal province contain large amounts of chromium, lead, silver, vanadium, and zinc associated with organic matter and carbonate minerals. High concentrations of cobalt, copper, molybdenum, nickel, lead, thallium, and zinc occur in close association with organic matter and pyrite in samples of the Houy Formation of Devonian and Mississippian age in central Texas.—JDV

02546 **Vine, James D.** Element distribution in some Paleozoic black shales and associated rocks: U.S. Geol. Survey Bull. 1214-G, p. G1-G31, illus., tables, 1969.

Four sets of Paleozoic black-shale samples were analyzed chemically and statistically in search of geochemically significant element associations. Units included in the sample sets are Pennsylvanian black shales from Kansas and Oklahoma, the Permian Phosphoria Formation, the Devonian Chattanooga Shale, and the Pennsylvanian Paradox Member of the Hermosa Formation. Silicon, aluminum, titanium, gallium, and zirconium are the principal elements in the detrital mineral fraction. Elements associated with organic matter include chromium, copper, lead, molybdenum, nickel, vanadium, and calcium in the Pennsylvanian shales of Kansas and Oklahoma; chromium, copper, molybdenum, nickel, scandium, selenium, lanthanum, vanadium, yttrium, and zinc in the Phosphoria; cobalt, iron, molybdenum, nickel, and uranium in the Chattanooga; and copper and zinc in the Paradox.—JDV

07523 **Viswanathan, K.** A systematic approach to indexing powder patterns of lower symmetry using De Wolff's principles: Am. Mineralogist, v. 53, nos. 11-12, p. 2047-2060, illus., table, 1968.

Using De Wolff's (1957) equations two centrosymmetrical reciprocal lattice planes are found which intersect along a common axis. Assuming the Q-value of a particular lattice point to be R, planes parallel to the centrosymmetrical planes are constructed. The value of R is found by considering the differences in the Q-values of a particular row of the parallel planes. The nature of distribution of equal Q-values on the parallel planes exhibit the symmetry of the crystal.—Author's abstract

Vitaliano, Charles J. *See* Daugherty, Franklin W. 02099

07572 **Vogel, Thomas A.; Smith, Bennett L.; Goodspeed, Robert M.** The origin of antiperthites from some charnockitic rocks in the New Jersey Precambrian: Am. Mineralogist, v. 53, nos. 9-10, p. 1696-1708, illus., tables, 1968.

[Analyses of feldspars in a Precambrian granite and plagioclase gneiss from northern New Jersey are presented.] Two alternate hypotheses are offered for the origin of the antiperthite: (1) The exsolution of microcline from plagioclase is permitted by the structure of plagioclase between An_{33} to An_{50}; exsolution of microcline does not occur in plagioclase of An_{22} to An_{33}. (2) Development of antiperthite is dependent upon the feldspar phase that crystallizes first. In the granite, the K-feldspar crystallized first; in the gneiss, the plagioclase crystallized first and the small amount of microcline then nucleated on low-energy surfaces of the plagioclase, such as twin planes, grain boundaries, and crystal imperfections.—*from* Authors' abstract

07592 **Vreeken, W. J.** Stratigraphy, sedimentology, and moisture contents in a small loess watershed in Tama County, Iowa: Iowa Acad. Sci. Proc. 1968, v. 75, p. 225-233, illus., table, 1968.

A traverse across a small first-order watershed in loess has been studied. The loess is Wisconsin in age and has a vertical tripartition that can be explained on a regional basis. Clear stratification is present in the middle loess increment. Moisture distribution patterns correlate highly with differences in particle-size distribution. The explanatory physical phenomena must be moisture-tension relationships.—Author's abstract

02148 **Wadsworth, William B.** Further data on Chayes' identity change number, a bulk coarseness estimator in granitic rocks [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 85-86, 1969.

07512 **Wahlstrom, E. E.; Robinson, C. S.; Nichols, T. C.** Swelling of rocks in faults in the Roberts tunnel, Colorado: Geol. Soc. America Eng. Geology Case Histories, no. 6, p. 83-89, illus., tables, 1968.

Samples of crushed and altered rock associated with faults were collected during the construction of the Roberts tunnel, Colorado, and were tested during a postconstruction study of the geology of the tunnel. The swelling properties and the mineralogy were determined and correlated with rock type and rock alteration. It was concluded that use of such tests at the time of construction could have aided in identifying potentially troublesome ground. Also, such tests, used in conjunction with surface examinations prior to the construction of a tunnel, would have indicated if swelling ground would be encountered during construction, and the order of magnitude of the swelling. – Authors' abstract

07508 **Wahlstrom, Ernest E.; Hornback, V. Q.** Engineering geology of Dillon dam, spillway shaft, and diversion tunnel, Summit County, Colorado: Geol. Soc. America Eng. Geology Case Histories, no. 6, p. 13-21, illus., 1968.

The Dillon dam, in Summit County, Colo., is a large earth-filled dam constructed on a foundation of faulted and extensively jointed Mesozoic sedimentary rocks. Geologic features determined by preliminary exploratory drilling and by detailed studies during the construction permitted close control of the foundation excavation and grouting operations. Special problems were created by heavy water flows from pervious gravels up to 80 feet deep that covered the bedrock in the valley floor of the Blue River, and by repeated movements of an ancient landslide reactivated during the dam construction, from loading by a temporary earth embankment and simultaneous excavation near the toe of the slide.—*from* Authors' abstract

Waldbaum, D. R. *See* Thompson, J. B., Jr. 07519

07520 **Waldbaum, D. R.; Thompson, J. B., Jr.** Mixing properties of sanidine crystalline solutions—[Pt.] 2, Calculations based on volume data: Am. Mineralogist, v. 53, nos. 11-12, p. 2000-2017, illus., tables, 1968.

Statistical analysis of the molar volume data for high-temperature alkali feldspars shows that the volume data in the monoclinic range may be fitted satisfactorily by a second degree curve. The excess molar volume of mixing may be represented by $V0_{ex} = 0.090\ N_{Or}N_{Ab}$ cal bar^{-1}. Analyses of standard deviations of data having restricted ranges of compositions indicate a discontinuity in the volume-composi-

tion curves between 33.7 and 38.6 mole percent $KAlSi_3O_8$. This discontinuity in volume is in the same composition range as a monoclinic-triclinic symmetry change at 25°C, established from plots of 2θ-values and lattice angles versus composition. —*from* Authors' abstract

Walker, R. M. *See* Fleischer, R. L. 02345

02209 **Walker, Thomas F.** Stratigraphy and depositional environments of the Lower Kootenai Formation in the Great Falls area, Montana [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 86, 1969.

02210 **Wall, John H.** Cretaceous foraminiferal faunas of the northern Alberta Plains [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 86-87, 1969.

02192 **Walters, L. J., Jr.; Luth, W. C.** Unit-cell dimensions, optical properties, halogen concentrations in several natural apatites: Am. Mineralogist, v. 54, nos. 1-2, p. 156-162, illus., tables, 1969.

Unit-cell dimensions, optical properties, and halogen and carbonate concentrations were determined for seven samples of natural apatite. The OH^- concentrations (determined by difference) were relatively constant for all samples, but CO_3^{2-}, Cl^- and F^- varied. The three types of apatite studied were high carbonate + fluor + hydroxy-apatite, high fluor + hydroxy-apatite, and chlor + hydroxy-apatite. The unit-cell parameters a and c, as well as the unit-cell volume (V), are sufficient to discriminate among the three types studied. Some carbonate substituted for phosphate in all samples. The isotopic composition of the carbonate reflects the origin of the apatite: the pegmatitic samples (relatively high-temperature origin) being much lighter in O^{18} than the sedimentary phosphate rock.—Authors' abstract

Waltz, J. P. *See* Mahar, James W. 02047

Waltz, J. P. *See* Freethey, G. W. 02094

02211 **Waltz, J. P.** Water transfer at bedrock-alluvium contacts in Colorado's designated ground water basins [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 87, 1969.

Waltz, J. P. *See* Pyle, William D. 02249

02212 **Wang, Yun Fei.** Recognition of thrusting in the Gilson Mountains, Juab County, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 87-88, 1969.

02576 **Warner, Jeffrey.** FORTRAN IV program for construction of pi diagrams with the Univac 1108 computer: Kansas Geol. Survey Computer Contr. 33, 38 p., illus., 1969.

Graphic analysis of fabric data by constructing orientation diagrams is a standard method in structural geology. In this computer program input is in the form of field or laboratory measurement, and is limited to 500 data points, but can be increased to 3,000 for a 32K machine. The program, listed in Appendix 2, is capable of performing rotations of any data set and constructing a new diagram, or combining any number of rotated data sets and constructing a summary diagram. Details of the input deck are given in Appendix 1, and samples of input and output are presented in Appendix 3.—ESL

07644 **Warren, M. A.; deLaguna, Wallace; Lusczynski, N. J.** Hydrology of Brookhaven National Laboratory and vicinity, Suffolk County, New York: U.S. Geol. Survey Bull. 1156-C, p. C1-C127, illus., tables, 1968.

The uppermost and principal aquifer in the area consists of 100-200 feet of permeable Pleistocene deposits. Recharge is by precipitation; discharge is mainly to surface bodies of water with lesser amounts going into lower artesian aquifers. Under favora-

ble conditions water moves from surface to water table at a rate of 30 feet per day; under less favorable, it may be one ft or less. A pumping test of a Laboratory well showed that the 45-ft saturated thickness of the aquifer has a transmissibility of 190,000 gpd, a field coefficient of permeability of 1,300 gpd per sq ft, and a specific yield of 0.24. Investigations 4 miles southwest of the Laboratory showed a transmissibility of 240,000 gpd, and field coefficient of permeability of 1,400 gpd per sq ft. Average rate of horizontal movement of water is 0.5 ft per day. Maps show water-table contours, hydrologic features of the Laboratory, and ground-water movement. —*from* Authors' abstract

02431 **Waters, Aaron C.; Fisher, Richard.** Maar volcanoes, western United States [abs.]: Northwest Sci., v. 43, no. 1, p. 44, 1969.

02572 **Watkins, N. D.** Non-dipole behaviour during an Upper Miocene geomagnetic polarity transition in Oregon: Royal Astron. Soc. Geophys. Jour., v. 17, no. 2, p. 121-149, illus., tables, 1969.

The paleomagnetism of a section of 71 successive lavas from southeastern Oregon is presented. During a polarity change 15 m.y. ago, there was an easterly-drifting non-dipole component. Maximum dipole intensity may have been as low as two percent of the present value for a period of not less than 100 years during the transition. A very short period of diminished relative dipole intensity occurred during the final stages of the polarity change, when the virtual geomagnetic pole returned to very low latitudes without any polarity change occurring. This "rebound" effect may reflect a fundamental aspect of the mechanism of polarity changes. The section may have accumulated in less than 50,000 years. The normally magnetized flows, which comprise most of the section, do not show any preferred association with lower or higher oxidation states.—DBV

02184 **Watson, K. D.; Morton, D. M.** Eclogite inclusions in kimberlite pipes at Garnet Ridge, northeastern Arizona: Am. Mineralogist, v. 54, nos. 1-2, p. 267-285, illus., tables, 1969.

Pyroxene in eclogite inclusions is essentially diopsidic jadeite. Coexisting garnet is pyropic almandine with an appreciable grossularite content. Chemically this eclogite differs from those found elsewhere as inclusions in kimberlite. Although the compositions of pyroxene and garnet resemble those in eclogite lenses in glaucophane schist terrains, there is no geological evidence at Garnet Ridge suggesting derivation from such a basement. Association of sparse eclogite inclusions with abundant xenoliths of granite and granite gneiss at Garnet Ridge suggests that the garnet-pyroxene rocks were derived from eclogite lenses in a migmatitic granite gneiss basement, but granite inclusions without eclogite in nearby diatremes do not favor this idea. The fact that this eclogite occurs in the same region as the Hopi Buttes soda-rich volcanic province raises the question of a genetic significance to this association.—*from* Authors' abstract

Watterson, J. R. *See* McCarthy, J. H., Jr. 02466

07646 **Watterson, Juan.** Homogeneous deformation of the gneisses of Vesterland, southwest Greenland: Medd. Grönland, v. 175, no. 6, 72 p., illus., geol. map, 1968; *reprinted as* Grönlands Geol. Undersögelse Bull. 78, 1968.

Structural development of the migmatitic gneisses is described by reference to successive fold episodes and then to the estimated pattern of three dimensional homogeneous strain. Mylonite zones are located along attenuated steep limbs of more open F_3 folds. In acid gneisses, F_2 folds are usually isoclinal, with axial planes and axes parallel to those of F_1 folds. In basic gneisses F_2 folds are open and both axes and axial planes differ from those of F_1 folds. Three mutually perpendicular axes can be recognized in penetration fabric of the gneisses, corresponding to principal axes of the strain ellipsoid. The strain ellipsoid corresponding to deformation in the acid gneisses is found to be of prolate type, with deformation path about 17, and axial ratios 1:3:100. The relationship between homogeneous deformation and styles and attitudes of F_1 and F_2 folds is discussed.—*from* Author's abstract

02394 **Wawersik, Wolfgang R.** Detailed analysis of rock failure in laboratory compression tests [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 8, p. 2916B, 1969.

07680 **Wayne State University; Parsons, Willard H.** (editor). Structures and origin of volcanic rocks, Montana-Wyoming-Idaho—Natl. Sci. Found. Summer Field Course 1968, Guidebook: Detroit, Mich., Wayne State Univ., 74 p., illus., tables, geol. maps, revised 1968; originally published 1965.

This field course, July 8-27, 1968, is a repetition of the 1965 course, but with considerable revisions and additions. The 14 field-course staff and guest lecturers represent various universities and the U.S. Geological Survey. Volcanic rocks of three major petrographic provinces are studied in Yellowstone National Park and in areas to the east and northeast in Wyoming and Montana and to the west in Idaho: Absaroka andesitic volcanics (Eocene), Yellowstone rhyolitic flows (Pliocene), and Quaternary basalt flows of the Snake River Plain. A new section on the American Falls, Idaho, area, by M. Prinz, and a revised section on the Gallatin Range and Yellowstone Valley, by R. A. Chadwick, are cited separately.—VMJ

Webster, Ruth M. *See* Dodd, John D. 07590

Weed, S. B. *See* Bowen, L. H. 02186

Wehr, Larry. *See* Dodd, John D. 07590

Weiblen, Paul W. *See* Kesler, Stephen E. 07521

02263 **Weiss, Malcolm P.** Oncolites, paleontology, and Laramide tectonics, central Utah: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 5, p. 1105-1120, illus., table, 1969.

Oncolites (algal stromatolites) in the North Horn (Late Cretaceous-Paleocene) and the Flagstaff (Paleocene-Eocene) Formations in Sanpete County and adjoining areas in central Utah are similar in structure to recent forms. Evidence indicates they are shallow-water, nearshore lacustrine facies. Oncolite beds in the area of study occur in several stratigraphic levels. From the stratigraphic and areal distribution of the beds several late-Laramide positive belts can be distinguished and a sequence of tectonic events can be outlined for the area.—SEF

02347 **Weissenborn, A. E.** (compiler). Geologic map of Washington: U.S. Geol. Survey Misc. Geol. Inv. Map I-583, scale 1:2,000,000, 1969.

02295 **Welby, Charles W.; Leith, Carlton J.** Miocene unconformity, Pamlico River area, North Carolina: Geol. Soc. America Bull., v. 80, no. 6, p. 1149-1154, illus., 1969.

A mid-Miocene angular unconformity appears on records from a high resolution "Boomer" survey of the Pamlico River, North Carolina. This unconformity is within the Yorktown Formation, and it is interpreted as indicating a shift in basinal axes during the deposition of the Yorktown Formation.—Authors' abstract

02355 **Weld, Betsy A.; Griffin, Margaret S.; Brett, George W.** Reports and maps of the Geological Survey released only in the open files, 1968: U.S. Geol. Survey Circ. 568, 24 p., 1969.

Wells, John D. *See* Elliott, James E. 02104

02554 **Wells, W. M.** Calculation of shrinkage of the Salmon cavity: Jour. Geophys. Research, v. 74, no. 10, p. 2791-2794, illus., 1969.

This letter presents a simplified analysis of cavity shrinkage which gives reasonably good agreement with the Salmon results, in which shrinkage of about 20 percent was observed in the first six months after the shot. The treatment is based on Hills' (1960) analysis for expansion of a spherical cavity, extended to cover the case of yielding upon unloading.—DBV

07583 **Wenckus, J. F.; Doherty, P. R.** Design and construction of a high pressure multipurpose crystal growing furnace [abs.], *in* Crystal growth 1968—Internat. Conf. Crystal Growth, 2d, Birmingham, U.K., 1968, Proc.: Jour. Crystal Growth, v. 3-4, p. 301, 1968.

07554 **Wenk, E.; Wenk, H.-R.; Schwander, H.** Bytownite from Cape Parry, East Greenland: Am. Mineralogist, v. 53, nos. 9-10, p. 1759-1764, illus., tables, 1968.

The chemical composition, optical orientation, and X-ray data are given for plagioclase phenocrysts from a porphyritic plagioclase-basalt dike in the syenitic intrusion of Cape Parry on Traill Island in East Greenland.—VSN

02188 **Wenk, Hans-Rudolf.** Annealing of oligoclase at high pressure: Am. Mineralogist, v. 54, nos. 1-2, p. 95-100, illus., table, 1969.

An oligoclase single crystal ($An_{13.5}Ab_{82.4}Or_{4.1}$) with low temperature structural and optical properties was annealed at 5-15 kbar and 800-1000°C in the presence of water vapor and in dry atmosphere. A sharp change in optical properties without intermediate states was observed to occur at 840°C ± 20; above this temperature the optical properties correspond to high-temperature plagioclase, below this temperature they correspond to low-temperature (plutonic) plagioclase. However, the unit-cell dimensions of both the optically high and optically low annealed plagioclases are nearly identical and correspond to a highly disordered structural state.—Author's abstract

Wenk, H.-R. *See* Wenk, E. 07554

07535 **Westbrook, J. H.; Jorgensen, P. J.** Effects of water desorption on indentation microhardness anisotropy in minerals: Am. Mineralogist, v. 53, nos. 11-12, p. 1899-1909, tables, 1968.

Water adsorption from ambient air is shown to affect significantly the relative values of the indentation microhardness as measured on different crystal planes of various minerals. Specific types of minerals studied include oxides, silicates, sulfides, fluorides, carbides, and carbonates.—Authors' abstract

Wetherill, G. W. *See* Kaushal, Sushil K. 02560

02432 **Wheeler, Harry E.; Mallory, V. Standish.** Columbia River Basalt as a critical Oregon Cascade datum [abs.]: Northwest Sci., v. 43, no. 1, p. 44-45, 1969.

Wheeler, Walter H. *See* Fallaw, Wallace. 02517

02354 **White, H. Gene.** The petroleum industry in Alabama, 1967: Alabama Geol. Survey Circ. 53, 27 p., illus., tables, 1969.

The discovery of two new fields in Choctaw County and productive extension of the Gilbertown field makes 1967 Alabama's most successful oil and gas year to date. It is anticipated that a strip of Jurassic production extending from Choctaw County to Escambia County will make this area a "Golden Lane" of oil production. In six counties there are 540 producing wells which yielded over 7 million bbl oil in 1967, for a total value of over 20 million dollars. Data are summarized in tables; a map shows fields, refineries, and pipelines.—MCM

White, J. R. *See* Chappell, B. W. 07557

02213 **White, Willis Harkness.** Structure and form of the Deep Creek stock, southern Seven Devils Mountains, Idaho [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 88, 1969.

02257 **Whitehead, Donald R.** Wind pollination in the angiosperms—Evolutionary and environmental considerations: Evolution, v. 23, no. 1, p. 28-35, 1969.

Analysis of theoretical aspects and experimental data on dispersal and capture of pollen-size particles provides insight into present distribution of anemophily and its probable evolution within angiosperms. Prerequisites for efficient wind transport of pollen include: fairly closely spaced individuals of the same species, open structure or deciduous habit of vegetation; close coordination of flowering and pollen release with most favorable season of the year (low precipitation, adequate winds, etc.). The environment of the tropical rain forest is unsuitable for anemophily; those of savannas and prairies are favorable. It is suggested that wind pollination and deciduous habit evolved together in response to seasonal drought as angiosperms migrated from the tropics into lower middle latitudes during early Cretaceous time.—VMJ

02520 **Whitehead, Donald R.; Doyle, Michael V.** Late-Pleistocene peats from Long Beach, North Carolina: Southeastern Geology, v. 10, no. 1, p. 1-16, illus., tables, 1969.

Two thin peat horizons, exposed along the Intracoastal Waterway, accumulated in shallow depressions in a Pleistocene barrier complex. The lower peat, 2.8 m above m.s.l., has a C-14 age of 36,000 yr, and the upper, 3.8 m above m.s.l., of 35,800 yr. The peats are underlain and overlain by dune sands and a thin layer of sand separates them. Pollen analysis indicates a localized cypress-gum-shrub swamp with mixture of northern and southern species. The depressions were periodically inundated by dune movement. This barrier complex was assumed to be interglacial; however, the mixed pollen flora and the radiocarbon dates suggest correlation with the mid-Wisconsin Port Talbot interstadial. The Long Beach barrier complex might have formed as result of a marine transgression, but in absence of critical geomorphologic work, alternative explanations are possible.—*from* Authors' abstract

02282 **Whitten, E. H. Timothy; Beckman, Walter A., Jr.** Fold geometry within part of Michigan basin, Michigan: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 5, p. 1043-1057, illus., tables, 1969.

In portraying the subsurface structure of gently folded areas, standard subjective methods permit significantly different structure contour maps to be drawn on the same bedding surface without violation of any of the drill data used; however, if fold geometry and fold descriptors were expressed in terms of quantitative numerical values, calculated subsurface portrayals should be more objective, more reproducible, and more realistic. This premise is illustrated by trend-surface analyses of the folded, subsurface Devonian (Dundee, Traverse, and "Brown") limestones of central Michigan, using an adapted double Fourier series trend-surface computer program for irregularly spaced data.—BHK

Wiesnet, D. R. *See* Collings, M. R. 02397

Wilcox, R. E. *See* Izett, G. A. 07538

02214 **Wilcox, Ray E.** Airfall deposits of two closely spaced eruptions in late glacial time from Glacier Peak Volcano, Washington [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 88-89, 1969.

Wilding, L. P. *See* Holowaychuk, N. 02170

02532 **Willard, Robert J.** Scanning electron microscope gives researchers a closer look at rock fractures: Mining Eng., v. 21, no. 6, p. 88-90, illus., 1969.

The U.S. Bureau of Mines has turned to the scanning electron microscope in its search for additional ways to increase the understanding of rock behavior. Since features indicative of the manner in which rocks fail may be recorded on the surface of fragments as disintegration proceeds, this microscope might provide a direct method of searching for and mapping these minute fractures.—Author's abstract

Willden, Ronald. *See* Kistler, Ronald W. 02137

07550 **Williams, D. W.** Improved cold seal pressure vessels to operate to 1100°C at 3 kilobars: Am. Mineralogist, v. 53, nos. 9-10, p. 1765-1769, illus., 1968.

The note describes the use of a T2M (molybdenum alloy) pressure vessel equipped with a Nimonic 75 alloy sheath to prevent oxidation. This new vessel does not require an argon gas jacket. Below 1100°C, the vessel can be operated at 3 kb, which exceeds the maximum pressure of earlier cold seal vessels.—JSH

02215 **Williams, J. Stewart; Southard, Alvin R.; Milligan, James H.; Summers, Paul.** Surficial geology of the Mount Pisgah quadrangle, Box Elder and Cache Counties, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 89, 1969.

Williams, J. Stewart. *See* Southard, Alvin R. 02223

07518 **Williams, Sidney A.** More data on greigite: Am. Mineralogist, v. 53, nos. 11-12, p. 2087-2088, 1968.

For an analyzed greigite with Fe:S ratio of 3:3.903 from Zacatecas, Mexico, the hardness, density, and cell edge were found to be 4, 4.049g/cc, and 9.875 A, respectively.—JLH

07568 **Williams, Sidney A.** Wickenburgite, a new mineral from Arizona: Am. Mineralogist, v. 53, nos. 9-10, p. 1433-1438, illus., tables, 1968.

Wickenburgite, a basic silicate of Pb, Al, and Ca, occurs in abundance at several prospects near Wickenburg, Ariz. It is an oxide zone mineral derived from lead ores and is associated with phoenicochroite, mimetite, cerussite, and willemite. The mineral is well crystallized to granular; white, colorless, or rarely pink. Luster is vitreous. Hardness is 5; $G = 3.85$ (meas), 3.88 (calc); fluoresces dull orange in short wave u.v. Crystals show dihexagonal dipyramidal symmetry, are tabular, and dominated by {0001} and {1011}. Morphological and Weissenberg data establish the space group as $P6_3/mmc$; cell parameters, from refined powder data are: a=8.53 A, c=20.16 A. The five strongest X-ray powder lines (in A) are 10.085 (10), 3.257 (8), 3.392 (6), 3.355 (4), and 2.639 (4). Wickenburgite is uniaxial (-).—*from* Author's abstract

Williamson, Allen D. *See* Palmer, James E. 02285

02288 **Williamson, Allen D.** Geology in the [Pennyrile Forest State] Park, *in* Middle and Upper Pennsylvanian strata in Hopkins and Webster Counties, Kentucky—Geol. Soc. Kentucky, Ann. Spring Field Conf. 1969: [Lexington, Ky.] Kentucky Geol. Survey, p. 15-19, illus., 1969.

Pennyrile Lodge is built upon a Caseyville sandstone cliff about 100 feet high, near which are good exposures of this Lower Pennsylvanian formation and Upper Mississippian beds. Two were flagged for interested field-trip participants. Across the lake, on the west side, steeply upturned beds lie upon conglomeratic sandstones of the basal Caseyville over upper Chester limestone (Kinkaid?), beneath which a normal fault may be concealed. West of the golf course, upper Chester limestone can be seen in an abandoned quarry, thin to thick bedded, oolitic near the base and argillaceous and fossiliferous near the top. Above a concealed interval, Caseyville sandstone caps the ridge.—GDC

Willman, H. B. *See* Frye, John C. 02302

02366 **Willman, H. B.; Frye, John C.** High-level glacial outwash in the Driftless Area of northwestern Illinois: Illinois Geol. Survey Circ. 440, 23 p., illus., tables, 1969.

New highway cuts about 4 miles southeast of East Dubuque expose outwash gravel not previously observed on the upland surface. Gravel and underlying clayey sandy silt rest on unevenly eroded Galena Dolomite at an elevation of 780-800 feet, about 200 feet above the Mississippi River floodplain. Although pebbles and cobbles are dominantly Galena Dolomite, sand from the matrix contains a glacial heavy mineral suite. Upland glacial outwash east of the Mississippi indicates the river was not in its present position until after Nebraskan glaciation. The Mississippi Valley and mature topography of the Driftless Area had largely developed by Kansan time. The river course through the Silurian escarpment is explained as an ice marginal feature. The

anomalous deep bedrock incision of the major valley may be the result of isostatic depression and marginal elevation caused by weight of the glaciers.—*from* Authors' abstract

Wilson, Charles W., Jr. *See* Moore, Gerald K. 07597

07598 **Wilson, Charles W., Jr.** Geologic map of the Short Mountain quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 323-SW, scale 1:24,000, separate text, 1968.

The accompanying text, "Mineral resources summary of the Short Mountain quadrangle, Tennessee," by C. W. Wilson, Jr. and L. C. Taylor is cited separately. —MCM

07609 **Wilson, Charles W., Jr.; Taylor, Landon C.** Mineral resources summary of the Short Mountain quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 5 p., 1968.

Mined resources in the Short Mountain quadrangle are limestone, sandstone, and gravel; a potential resource is chert. Of the several outcropping limestone formations, the Bangor, Monteagle, St. Louis, and Bigby-Cannon are best suited for most general uses. Sandstone occurs in the Rockcastle and Sewanee Conglomerates, and the Hartsell Sandstone. Chert gravel is present in beds and flood plains of larger creeks. This summary accompanies Tennessee Div. Geology Geol. Map GM 323-SW by C. W. Wilson, Jr. (cited separately).—MCM

02563 **Wilson, Eldred D.; Moore, Richard T.; Cooper, John R.** Geologic map of Arizona: Tucson, Ariz., Arizona Bur. Mines, scale 1:500,000, 1969.

07629 **Wilson, James F., Jr.** Time-of-travel measurements and other applications of dye tracing, *in* Hydrological aspects of the utilization of water—Gen. Assembly of Bern, 1967: Internat. Assoc. Sci. Hydrology Pub. 76, p. 252-262, illus.; discussion, p. 262-265, 1968.

Fluorescent dyes of the rhodamine family are popular hydrologic tracers because of the simplicity and sensitivity of fluorometric procedures. Time-of-travel is a general term used to describe downstream movement of water or water-borne materials with time. Several examples of its measurement are described; these illustrate that there is no apparent limit to the size or length of stream that can be measured, time-of-travel observed by tracing often differs from that computed from channel geometry and stream-flow data, excellent longitudinal dispersion information is gained, neither pools behind low dams or contamination have interfered with the success of this method, and traveltime is a function of stream flow. Examples of dye tracing in estuarine dispersion studies, herbicide tracing, and ground-water studies are included.—*from* Author's abstract

02149 **Wilson, John C.** Ore-magma relation at Bingham, Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 90, 1969.

Wilson, William F. *See* Allen, Eldon P. 07663

Winter, T. C. *See* Maclay, R. W. 02329

02284 **Wise, William S.** Geology and petrology of the Mt. Hood area—A study of High Cascade volcanism: Geol. Soc. America Bull., v. 80, no. 6, p. 969-1006, illus., geol. map, 1969.

This field and geochemical study was aimed at obtaining evidence on the origin of andesitic magma centered about Mt. Hood, Oregon, one of the High Cascade volcanoes. Volcanic rocks studied range in age from late Miocene to Recent and include olivine basalt, olivine and pyroxene andesite, and olivine, pyroxene, and hornblende dacites. Geochemical data obtained from 158 analyzed samples coupled with the field study lead to the following conclusion: Mt. Hood lavas did not differentiate from

high alumina basalt nor from any single differentiation series. Some are differentiates of contaminated olivine basalt, others are related to a primary andesite.—RGY

02150 **Wobus, Reinhard A.** Granitic rocks of the Florissant quadrangle, southern Front Range, Colorado [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 90, 1969.

02325 **Wolfe, W. J.; Wright, G. R.** (compilers). Operation Pukaskwa—Cold extractable total heavy metals in stream and spring sediments, University River and Pukaskwa River sheets, Districts of Algoma and Thunder Bay: Ontario Dept. Mines Prelim. Geochem. Map P. 508, 2 sheets, scale 1 in. to 1 mi., text, 1969.

02326 **Wolfe, W. J.; Wright, G. R.** (compilers). Operation Pukaskwa—Geochemistry of copper in stream and spring sediments, University River and Pukaskwa River sheets, Districts of Algoma and Thunder Bay: Ontario Dept. Mines Prelim. Geochem. Map P. 509, 2 sheets, scale 1 in. to 1 mi., text, 1969.

02327 **Wolfe, W. J.; Wright, G. R.** (compilers). Operation Pukaskwa—Geochemistry of zinc in stream and spring sediments, University River and Pukaskwa River sheets, Districts of Algoma and Thunder Bay: Ontario Dept. Mines Prelim. Geochem. Map P. 510, 2 sheets, scale 1 in. to 1 mi., text, 1969.

02435 **Wolfe, W. J.; Wright, G. R.** (compilers). Operation Pukaskwa—Geochemistry of manganese in stream and spring sediments, University River and Pukaskwa River sheets, Districts of Algoma and Thunder Bay: Ontario Dept. Mines Prelim. Geochem. Map P. 511, 2 sheets, scale 1 in. to 1 mi., text, 1969.

02436 **Wolfe, W. J.; Wright, G. R.** (compilers). Operation Pukaskwa—Geochemistry of nickel in stream and spring sediments, University River and Pukaskwa River sheets, Districts of Algoma and Thunder Bay: Ontario Dept. Mines Prelim. Geochem. Map P. 512, 2 sheets, scale 1 in. to 1 mi., text, 1969.

07536 **Wollast, Roland; MacKenzie, Fred T.; Bricker, Owen P.** Experimental precipitation and genesis of sepiolite at earth-surface conditions: Am. Mineralogist, v. 53, nos. 9-10, p. 1645-1622, illus., tables, 1968.

Reaction of aqueous silica with sea water produces a hydrated magnesium silicate similar to sepiolite. Sepiolite is the only non-aluminous, cation-bearing silicate that can be precipitated directly from sea water. Cations other than Mg^{2+} are not involved in the precipitation of this compound. The equilibrium constant for the formation of $Mg_2Si_3O_8(H_2O)_n + 4H^+$ has been determined experimentally at 25°C and one atm total pressure and the $\Delta G°_f$ of dehydrated sepiolite calculated to be -903.3 ± 0.5 kcal/mole. Stability relations in the system MgO-SiO_2-H_2O at 25°C and one atm total pressure are examined and models for the genesis of sepiolite are discussed.—*from* Authors' abstract

Wolters, Gale L. *See* Glover, Robert K. 07684

02315 **Wood, J.** Township 151 and Township 145, District of Algoma: Ontario Dept. Mines Prelim. Geol. Maps P. 531-532, scale 1 in. to 1/4 mi., text, 1969.

02205 **Woodward, Lee A.** Large-scale tectonic bending associated with major thrust plate, western Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 91, 1969.

02206 **Woodward, Lee A.; O'Neill, Michael J.** Precambrian carbonate rocks of the Pilot Range, Nevada and Utah, and their regional significance [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 91-92, 1969.

02207 **Worl, Ronald G.** Superposed folding in Precambrian taconite, Northern Wind River Mountains, Wyoming [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 5, Rocky Mtn. Sec., p. 92, 1969.

02527 **Wright, Fred D.** Rock mechanics and coal mining: Mining Eng., v. 21, no. 2, p. 112-113, 1969.

Articles published during 1967 and 1968 which discuss a variety of applications of rock mechanics to coal mining are reviewed.—MAC

Wright, G. R. *See* Wolfe, W. J. 02325

Wright, G. R. *See* Wolfe, W. J. 02326

Wright, G. R. *See* Wolfe, W. J. 02327

Wright, G. R. *See* Wolfe, W. J. 02435

Wright, G. R. *See* Wolfe, W. J. 02436

Wright, W. B. *See* Cohee, G. V. 02276

02499 **Wuenschel, P. O.; Treitel, Sven; Flinn, E. A.; Keller, G. V.; Pickett, G. R.** Geophysical research and progress in exploration, 1965-1968: Geophysics, v. 34, no. 2, p. 145-154, 1969.

This is a progress report on developments in geophysical research and progress in exploration from 1965 to 1968. Progress in seismic methods, gravity and magnetic methods, electric methods, and well logging and formation evaluation are discussed. —KAF

Wyllie, P. J. *See* Boettcher, A. L. 02483

Wyllie, P. J. *See* Davidson, A. 07640

02539 **Yamanaga, George; Huxel, C. J.** Preliminary report on the water resources of the Lahaina District, Maui: Hawaii Div. Water and Land Devel. Circ. C51, 47 p., illus., tables, 1969.

The Lahaina District [Hawaii] occupies about 96 sq mi on the west side of the West Maui volcanic dome, in the center of which numerous intersecting dikes impound a large high-level ground-water body. From this body, perennial streams derive their base flow; low flow exceeds 25 mgd. Basal ground water, in a peripheral belt, surrounds the area of high water; pumpage from it averages about 50 mgd. Absence of extensive caprock along the shore allows hydraulic continuity and free circulation between sea water and fresh; the fresh-water lens is thin near the shore. Heavy pumping, even 3,000 feet inland, results in large though temporary increases in salinity. Leakage of high-level water through boundary dikes is probably the main recharge source for the basal-water body. The high-level water body appears to be the most promising source of additional domestic supply.—*from* Authors' abstract

02555 **Yochelson, Ellis L.** Stenothecoida, a proposed new class of Cambrian Mollusca: Lethaia, v. 2, no. 1, p. 49-62, illus., 1969.

Cambridium, *Stenothecoides*, *and Bagenovia*, composing the family Cambridiidae and a monotypic superfamily and order, were assigned questionably to Monoplacophora by Knight and Yochelson (1960), who assumed the animals were univalves. *Stenothecoides* is shown to be bivalved, by a specimen of an undescribed Siberian species, and one of *S. knighti*, n. sp., here described, from a Lower Cambrian limestone in Yukon near the Alaskan border. The asymmetric bivalved shell, and short interior ridges normal to the shell margin (found also in *Cambridium*), are considered of class-rank significance; the extinct class Stenothecoida is proposed for these genera. The assignment of *Bagenovia*, also bivalved, remains questionable until interior shell structure is discovered. The animals may have been functionally similar to brachiopods.—VMJ

02384 **Yorath, C. J.; Balkwill, H. R.; Klassen, R. W.** Geology of the eastern part of the northern Interior and Arctic Coastal Plains, Northwest Territories: Canada Geol. Survey Paper 68-27, 29 p., illus., table, geol. map, 1969.

Bedrock geology of this Arctic region is depicted on a sketch map. The glaciated Interior Plains, uplands and plateaus are dominated by the Amundsen and Great Bear lobe moraines; on the northwest, the Arctic coastlands are lake-strewn, Quaternary alluvium. Three broad structural provinces divide the Interior Plains: Anderson Plain, a west-dipping homocline of Middle Paleozoic, Cretaceous and Tertiary(?) rocks; Horton Plain, featureless, underlain by Ordovician-Silurian, Devonian and Cretaceous strata, bounded on west by a west-dipping monocline; and Coppermine Arch, a complex asymmetrical anticline formed by Proterozoic, Paleozoic and Cretaceous rocks. Distribution and lithology of the stratigraphic units are described, noting thickness, unconformities, correlation with Arctic islands, and economic potential, particularly reservoir properties for possible hydrocarbon accumulation. –GDC

02173 **Young, Cortland E., Jr.** Water table, soil moisture, and oxygen diffusion relationships on two drained wetland forest sites: Soil Sci., v. 107, no. 3, p. 220-222, illus., 1969.

This represents the results of a study designed to investigate the relationship of fluctuating water table to the moisture and aeration status of forest land. The oxygen-diffusion rate was positively related to depth of water table. The oxygen diffusion rate was different for each type of soil because the soil porosity was different. –JWH

02450 **Young, Grant M.** Geochemistry of early Proterozoic tillites and argillites of the Gowganda Formation, Ontario, Canada: Geochim. et Cosmochim. Acta, v. 33, no. 4, p. 483-492, illus., table, 1969.

The average chemical composition of the matrix of 16 lower Proterozoic (Gowganda Formation) tillites from Ontario is given. There are significant differences between chemistry of tillite matrix materials in eastern and western parts of the Gowganda outcrop belt in agreement with results of paleocurrent studies which indicate a high percentage of Archean volcanic and sedimentary rocks in the hinterland of the eastern region and a dominantly 'granitoid' source in the west. The 'varved' argillites show a remarkable compositional homogeneity; they contain less silica and more alumina, magnesia and potassium than the tillites. The Na_2O/K_2O ratios of the tillites are consistently high, comparable to the basement rocks and higher than in argillites. Compared with the Archaean Canadian Shield, the tillites have a relative Fe and Mg enrichment, explained by preferential breakdown of mafic minerals.—*from* Author's abstract

02174 **Yuan, T. L.** Composition of the amorphous materials in the clay fraction of some entisols, inceptisols, and spodosols: Soil Sci., v. 107, no. 4, p. 242-248, tables, 1969.

The clay fractions of 9 virgin soil profiles were analyzed for amorphous materials by treatments of 0.5N NaOH and buffered by $Na_2S_2O_4$. Amorphous materials comprised up to 64 percent of the clay fraction in surface soils and 64.4 percent in the subsoil. The results of this study show that a relationship exists between amorphous SiO_2:Al_2O_3 ratio in the clay and degree of soil development. The greatly varied ratios observed suggest that the amorphous materials in the clay fraction probably contained large amounts of free oxides in addition to allophanic silicates. –JWH

Yund, Richard A. *See* Rutstein, Martin S. 02198

07553 **Zeidler, W.** Preparation of thin film sections: Am. Mineralogist, v. 53, nos. 9-10, p. 1773-1774, 1968.

A new technique for the preparation of petrographic (rock, mineral, coal) thin film sections is presented in which the section is freed from the glass slide and coated with soluble transparent plastic.—JLH

Zeller, Doris E. *See* Jewett, John Mark. 07665

02569 **Zenkevich, N. L.** New bathymetric data on the northeastern Pacific, *in* Oceanographic research by the "Vityaz" in the North Pacific under the I.G.Y. program (translated from Russian, Akad. Nauk SSSR Inst. Okeanologii Trudy, v. 45, 1961): Springfield, Va., U.S. Clearinghouse Federal Sci. and Tech. Inf., p. 3-17, illus., 1969.

A bathymetric map of the northeastern Pacific Ocean floor is presented based on data from the 29th voyage of the "Vityaz" from October 5, 1958 to March 14, 1959. The route extended from Tsugaru Strait to the Kurile Islands, south to the Hawaiian Ridge, north to the Gulf of Alaska and down the North American Coast to the southern Gulf of California and then across the Pacific to Tsugaru Strait. Features described include the Kurile-Kamchatka Trench, the Hawaiian Ridge, the Aleutian Trench, the Gulf of Alaska, the continental slope and margins of North America including various fracture zones, the Hawaiian arch, and features between the Hawaiian and the Asiatic coast.—VSN

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